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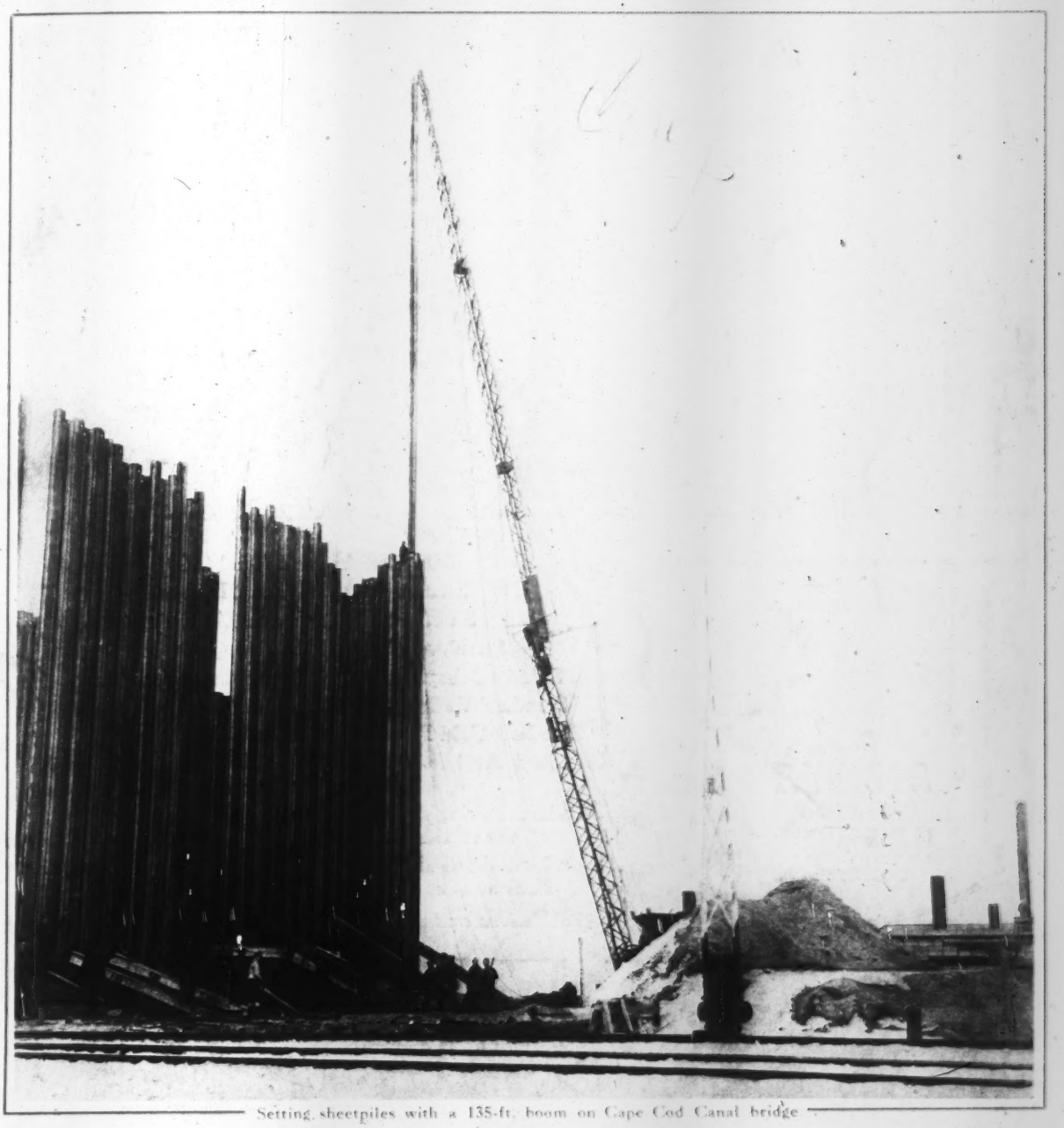

Setting sheetpiles with a 135-ft. boom on Cape Cod Canal bridge

Open Cofferdams in Glacial Drift . . . Column Base-Plate Design . . . Mississippi Valley Committee Report . . . Accident Compensation Rates . . . Bonnet Carré Spillway Trestles . . . Track and Higher Speeds . . . Well-Equipped Road Work

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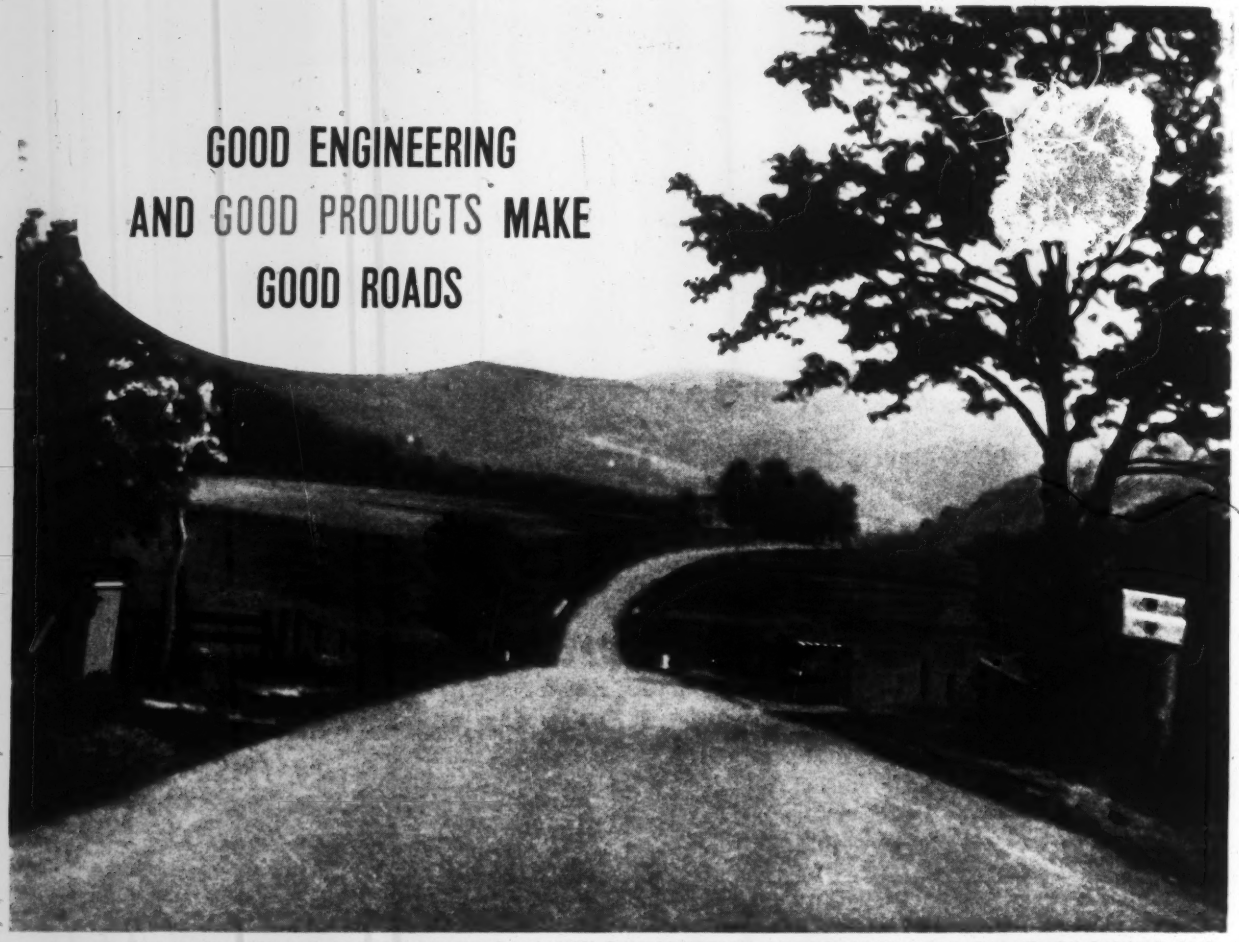

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Happy New Year!

TRADITION has made the Christmas season and the advent of a New Year an appropriate occasion for the public expression of good-will and good wishes. So, in that spirit, this writer here records his grateful acknowledgment to all those who, through their readership, counsel, comment and advertising patronage, have helped this journal during the past year to carry on its work in behalf of the engineering profession and the construction industry. And to all whose interests may touch those far-reaching activities he offers hearty good wishes for a Happy New Year.

But after all, that is but a phrase. And is it not true that no one of us can hope really to be happy at the expense of others? If we all are to have a Happy New Year does it not follow that somehow each must help others also to enjoy one? What kind of New Year's wish, then, should mean the most to each of us and at the same time contribute most to the general good? Let us begin at the top.

To the President: A wish that you, Sir, may have the vision, wisdom and courage neither to abandon the progressive aspirations of the New Deal nor to sacrifice the genuine progress that has been achieved under the Old, to ignore equally the cynical denunciation of the new by selfish and complacent Bourbons, the reckless urgings of bigoted and fanatic reformers and the misguided agitation of honest and sincere people who cannot or will not think in terms of the common welfare and are swayed wholly by leadership that points only to immediate class-interest.

To public officials: That you may find means to relieve distress within your jurisdictions without continued exploitation of the construction industry, that you may be able to provide useful employment on public construction through the normal use of existing professional and construction organizations thereby contributing to true recovery, that you may contrive to balance your public budgets by means that will not misuse special taxation and bear inequitably on highway users or other particular groups.

To engineers and architects: That a resumption of private investment and a restriction of the governmental practice of employing professional men on a relief basis may make it possible for you to rehabilitate those trained and talented organizations you had assembled over many years, that you may find it possible to exert your great professional influence for the better administration of the construction industry.

To contractors: That the invasion of the construction business by public agencies may be restricted to the very minimum consistent with the public welfare and that when public work *must* be done by direct labor, the responsible agencies may be bound by the same conditions and requirements that govern you, that, in your relations with other elements of the construction industry, you may be able to contribute substantially toward correcting old evils and establishing higher standards of practice.

To construction labor: That a rising tide of construction, both public and private, may increase your actual earnings by making available more days of employment for more men; for that would mean far more to you than the arbitrary establishment of wage scales that must remain sterile when they are too high to encourage more work.

To manufacturers of materials and equipment: That increasing private investment and a rational and normal conduct of public construction for recovery rather than for relief may foster increasing demand for your products and employment for your people, that experience to date may so improve code administration as to avoid penalizing the producer who tries to play the game squarely, that the opportunities for better business opened up by improvement in general conditions may find your organizations alert to seize them.

To distributors of construction equipment: That by now the scrapping of worn-out and obsolete equipment may at last have been completed; that the manufacturers may produce and promote improved products to strengthen their standard lines and thereby help you to reequip your prospects, that this reequipment job will find you packing the same old selling punch that in other days won for the distributor his important place in the industry.

These are but wishes. They can be realized only through intelligent and aggressive effort all along the line. In other words, each of us, after all, has a lot to do with putting that "Happy" into his own "Happy New Year."

Willard Chevalier

ENGINEERING NEWS-RECORD

Published every Thursday. Vol. 114, No. 1. Price 25c. per copy. Subscription, domestic, Mexico, Central and South American countries, $5 per year. Canada, including duty, $7.50. All other countries, $9 a year or 36 shillings. Entered as second-class matter April 11, 1917, at the Post Office at New York, N. Y., under the Act of March 3, 1879. Printed in U.S.A. Cable Address "McGrawhill, New York." Member A.B.P. Member A.B.C. Copyright 1934 by

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

Editorial and Publishing Offices: 330 West 42d Street, New York; 520 North Michigan Avenue, Chicago; 883 Mission Street, San Francisco; Aldwych House, London, W. C. 2, England. Branch Offices: Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Greenville, S. C.

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A "Caterpillar"-powered Schramm Compressor supplying air for drilling on a construction job near Salem, Virginia.

SCHRAMM COMPRESSORS USE "CATERPILLAR" DIESEL POWER

—and Schramm, Inc., of West Chester, Pa., says: "We offer them in the full belief that there are no better compressors built."

Schramm, Inc., chose "Caterpillar" Diesel Engines to win the advantages of

- —STURDY, ECONOMICAL, EFFICIENT POWER
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Other manufacturers, for the same reasons, have adopted "Caterpillar" Diesel power for their compressors, shovels, drag lines, crushers, generators, industrial locomotives and other equipment. They have been rewarded by increased sales and increased customer-satisfaction. Caterpillar Tractor Co., Peoria, Illinois, U.S.A.

AMERICA GOES DIESEL

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In the News:

JANUARY is the month of annual conventions, and Washington is the place. The schedule includes: American Engineering Council, Jan. 10-12; American Road Builders, Jan. 22-25; A.G.C., Jan. 28-30. There is also the Am.Soc.C.E. annual meeting in New York, Jan. 16-18.

AFTER the stalemate of the plan for allocating storage rights at Boulder Dam to Arizona, resulting from the Washington conference of Dec. 17, the next step has been a proposal by Governor Blood of Utah, representing the six basin states, to Governor Moeur of Arizona for a new conference of representatives "to get together in a friendly way and calmly discuss the issues."

AS PART of the six-year plan of the Mexican government, a subsidized railroad company has been organized to build and equip three new lines to the West Coast of the country and one to the Gulf Coast.

MEMBERS of the Am.Soc.C.E. voted 3,152 to 703 to amend the society's code of ethics to make it unethical "to use the advantages of a salaried position to compete unfairly with other engineers."

DECENTRALIZATION of the PWA organization for the coming program has been advocated by Administrator Ickes so that "We can act much more rapidly in approving projects."

THE ENGINEERING COUNCIL has established an office to sponsor the employing of engineers in federal departments in positions for which they are better fitted than persons without technical training.

In This Issue:

HIGHWAY CONSTRUCTION on a 10½-mile section of trunk-line road illustrates advanced modern practice in the mechanizing of grading work and the operations of bituminous surfacing.

CONTRACTORS have much to learn about compensation insurance rates and their relations to construction accidents. An article outlines the basis for rate making.

BUILDING of the Bonnet Carré flood-relief channel about 20 miles up the Mississippi River from New Orleans necessitated the raising of three railroad lines and a major highway. The design and construction of these four trestles, each more than a mile long, which utilize unusual combinations of timber, steel and concrete, are described.

BOULDER-LADEN GRAVEL, which presented especially severe problems in sheetpile driving and necessitated an elaborate system of well points, was the difficult foundation material encountered in building piers for three bridges across the Cape Cod Canal. Cofferdam construction is described.

An analogy between concrete-beam design and the calculating of column base-plate requirements is developed to simplify base-plate design and provide an easily applied method.

A REPORT on planning for the great central area of the United States has grown out of a study which had as its initial objective a plan for the conservation and use of the waters of the Mississippi basin, a plan which would give the PWA criteria for the approval or rejection of river development projects put up to it for financing. The Mississippi Valley Committee of the PWA, in attempting to prepare such a plan, found that water touched so many fields of human activity so closely as to require it to go even into the subject of the market for electricity.

THE IMPROVEMENTS in railway track made necessary by the introduction of the new high-speed trains and the speed reduction required in specified zones are reviewed, as they have been worked out for the Burlington Lines.

Coming Articles:

A CENTURY AND A HALF AGO, at the instigation of Alexander Hamilton, there was incorporated in New Jersey the Society for the Establishment of Useful Manufactures, a now ancient corporation which for a long time has been popularly called the SUM. The purpose of the organization is indicated by its name, and it represented a regional development project of pioneer days that was somewhat comparable to the drainage-basin projects now getting under way in other regions of the country. Its history, with special attention to its involvements in New Jersey water-supply problems, will appear in an article next week.

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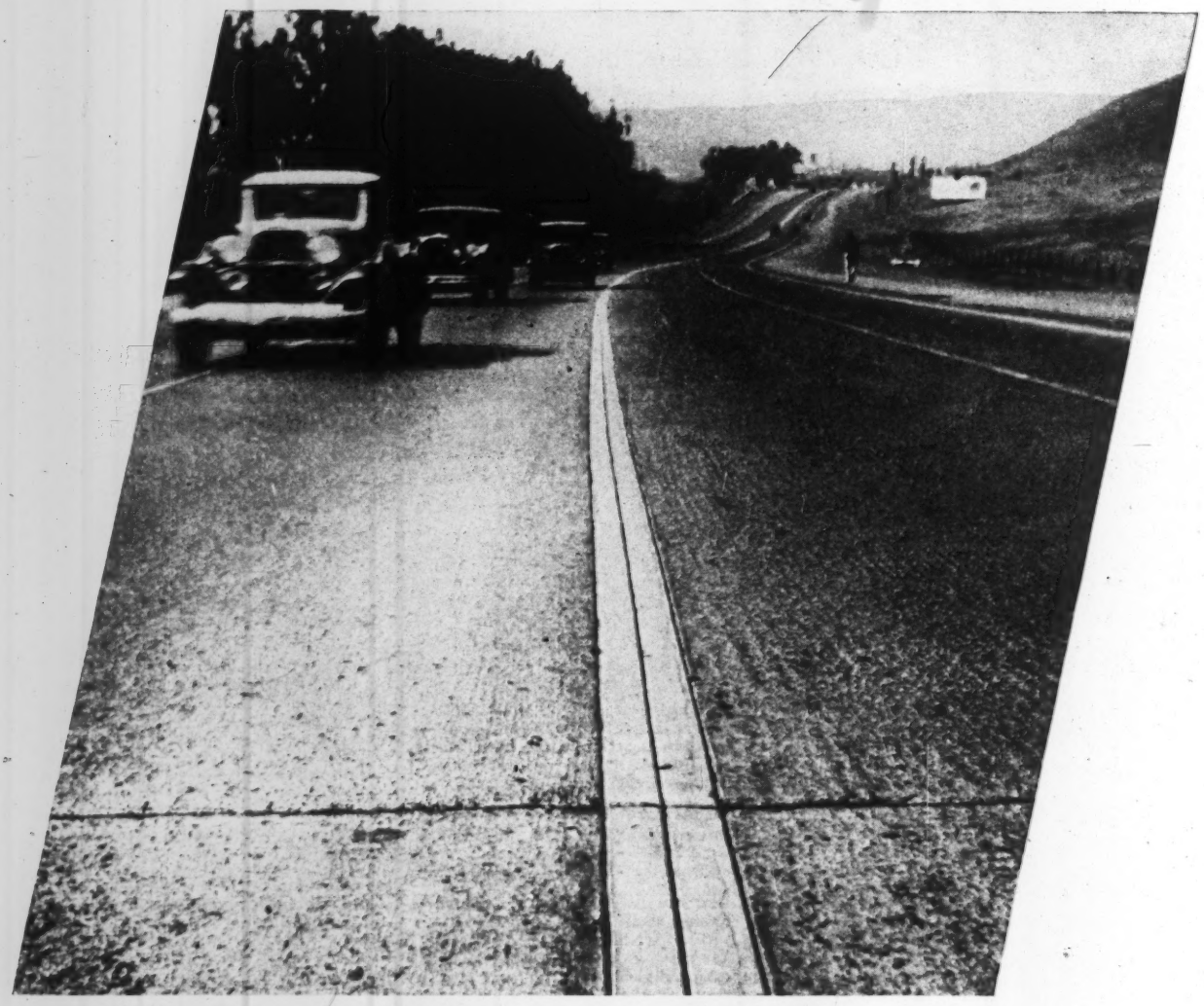
An index for Volume 113, July-December, 1934, will be published with the issue of Jan. 10.

Indelible white concrete traffic markers END REPLACEMENT COST!



Double white concrete traffic marker in concrete pavement, Bayshore Boulevard, San Francisco. Installed by Basich Bros., Los Angeles.

WHAT is an *indelible* marker? The dictionary says that something *indelible* is something that cannot be blotted out or effaced. Atlas White traffic markers meet that definition. Built of permanent white concrete, they *stay* white, year after year. Neither weather nor traffic can blot them out or efface them. They are *indelible*. But their cost is far from indelible, because their cost is soon erased by the saving in maintenance. These markers require no maintenance. They last as long as the pavement lasts—always and *indelibly* white. Write for full details to Universal Atlas Cement Co., *Subsidiary of United States Steel Corporation*, 208 South La Salle Street, Chicago.

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January 3, 1935

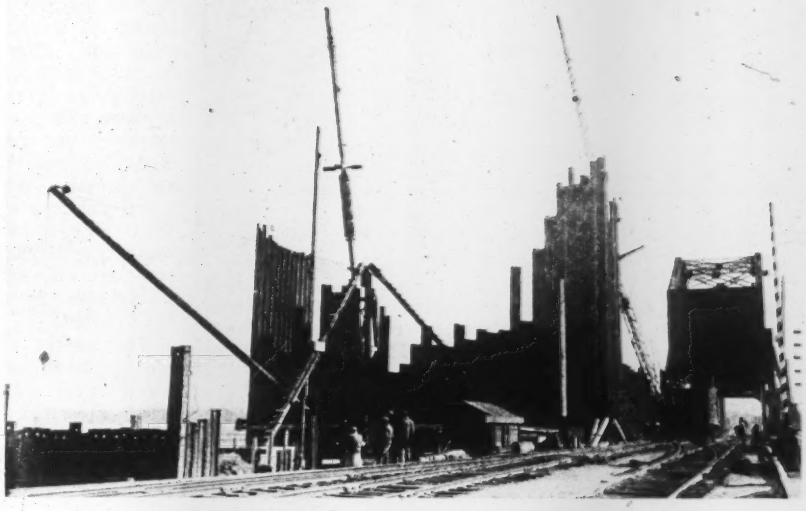


FIG. 1—IRREGULAR EDGE of top of cofferdam sheeting for north pier of new railroad bridge over Cape Cod Canal attests to presence of boulders in glacial drift through which sheeting is being driven.

Sinking Open Cofferdams Through Glacial Drift

Boulder-laden and water-bearing material at pier sites of three new Cape Cod Canal bridges presented difficulties that were overcome only by elaborate well-point installation and tedious and careful excavation

IN SINKING PIERS through a glacial drift of sand, gravel and boulders for three new bridges over the Cape Cod Canal in Massachusetts, serious difficulties were encountered, and only by persistent driving of steel sheeting and the use of one of the most elaborate well-point systems yet utilized on bridge-foundation work were the difficulties overcome. The construction procedure as well as the foundation material, whose action comprised an interesting demonstration of some of the phenomena of soil mechanics, make the job an unusually instructive one.

The channel piers were planned to be founded on the natural sand or gravel at about 55 ft. below mean sea level in the canal at the two highway bridges and at about 60 ft. at the railroad bridge, and the construction contracts were made on this basis and under a plan to build the piers by open-cofferdam methods, using steel sheeting. Unexpected difficulty was encountered in driving the sheeting, due to the presence of numerous boulders, and it became practically impossible to drive the sheeting to the depths necessary to permit the required excavation. Moreover, considerable trouble was caused by the flow of the sand beneath the sheeting, where boulders prevented its being driven to grade, and by the flow through the sheeting where it had become deflected or split from contact with boulders. In some cases blasting of the boulders caused the saturated sand outside the sheeting to boil up from beneath the sheeting to a height of several feet, and the bottom became "quick."

It was deemed advisable by the contracting officer of the Corps of Engineers and by the consulting engineers to excavate to a lesser depth and to provide equivalent bearing by driving timber foundation piles. The use of such piles would act to stiffen the underlying sand and prevent it from becoming quick below the bottom of the excavation.

The Cape Cod Canal bridges (*ENR*, Jan. 25, 1934, p. 107) are being built by the federal government under the direction of the War Department, to permit more efficient operation of the canal by eliminating the delays caused by drawbridge openings. The two new highway bridges are fixed structures of continuous-truss type with 616-ft. main spans, providing a minimum vertical clearance of 135 ft. for shipping. They are located at Sagamore, near the east end of the canal, and at Bourne, 4 miles distant, near the west

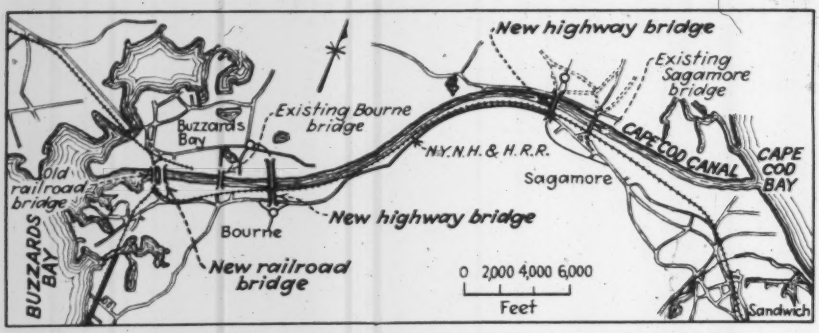


FIG. 2—LOCATION of three new bridges being built over Cape Cod Canal. Six piers near water's edge (two per bridge) presented special construction difficulties.

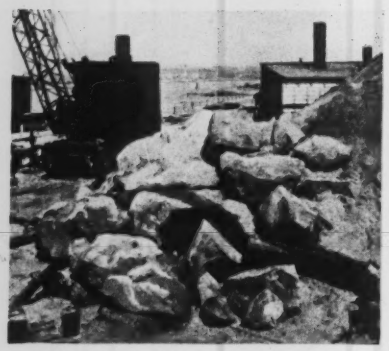


FIG. 3—TYPICAL medium-size boulders removed from pier excavations on Cape Cod Canal bridges. The two largest boulders removed were of 90-cu.yd. size.

end. The railroad bridge, a mile west of the Bourne bridge at the village of Buzzards Bay, is a 544-ft. lift span (the longest yet built), which, it is planned, will be left in its open position, providing 135-ft. shipping clearance and lowered only for the trains that will occasionally have to use it.

In the aggregate these bridges required sixteen different foundations for piers and abutments, but only those near the water's edge presented unusual difficulties. These latter included the two main piers on each of the highway bridges, the two piers under the front legs of the lift bridge towers and, to a lesser degree, the two piers under the rear legs of these towers.

Foundation material

Cape Cod, as is well known and as was shown in more detail by the wash borings made at the pier sites, is a glacier deposit (of granite gravel) containing numerous granite boulders. What was not known and was only revealed by the foundation operations was the variable amount of boulders at different locations and different depths, the relatively large size of many of the boulders and a variability in the charter of the boulders at the several piers. With respect to the latter, the boulders at the Bourne bridge and particularly at the south pier we extremely angular, while elsewhere, is usually characteristic of glaciat material, they were smooth and rel tively round. The angular boulde would not "run" and thus could not excavated with clamshells; this sou pier at Bourne as a consequence w excavated almost entirely by hand.

In the other piers the rounde boulders occurred indiscriminately an in large numbers. The contractor ha assumed that about 10 per cent of th sheeting for each excavation woul strike boulders that would require careful removal. Actually the number wa much greater, and at the north Buzzards Bay pier at the edge of the canal nearly eight times the assumed numbe were encountered. Two boulders, approximating 90 cu.yd. in size, had to be removed.

The matrix of sand and gravel in which these boulders occurred was fairly stable and solid when dry, but when saturated it acquired the characteristics of a quicksand. In addition, when disturbed, as by the jarring from piledriving, it settled perceptibly. In this unstable condition and under the high hydrostatic head, blowouts of the bottoms were frequent when attempts were made to unwater the cofferdams.

While foundation sinking for all piers followed the same general procedure, certain piers proved more difficult than others, and variations in method followed. The south Bourne pier as stated did not require piles but was in other ways very difficult. The south Sagamore pier may be considered typical of the other highway

FIG. 4—CANAL SPAN PIERS under construction for Sagamore highway bridge. Corresponding piers on Bourne highway bridge are similarly located with respect to canal.

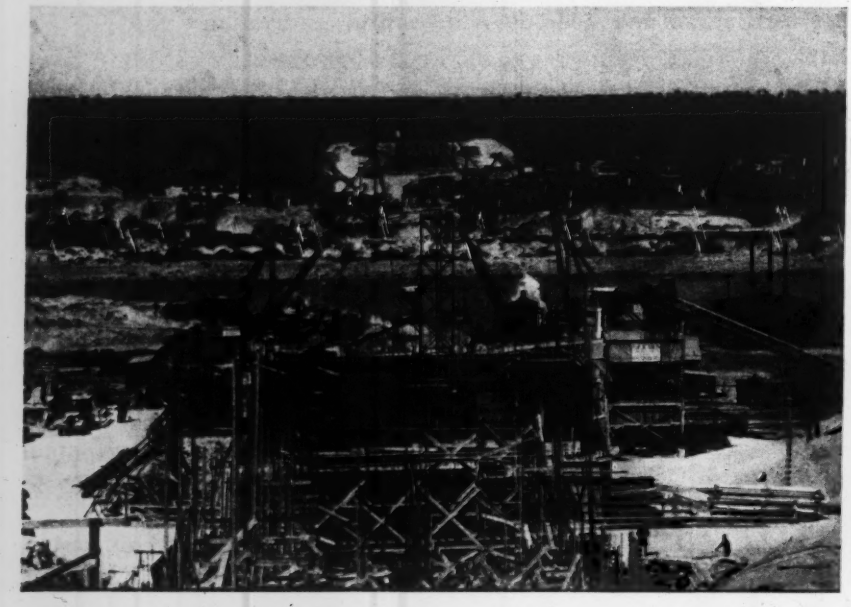
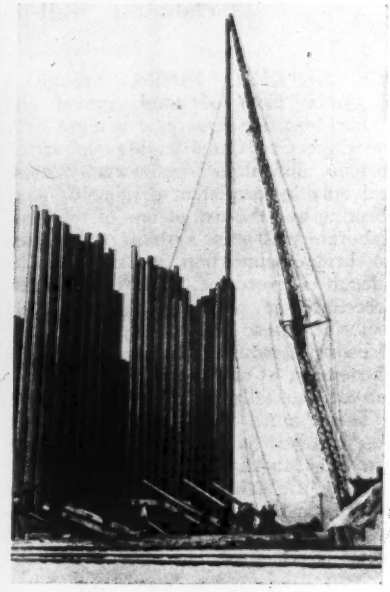


FIG. 5—NOVEL LASHING and trussing permitted two standard crane booms to be spliced into a 135-ft. length for handling the 65-ft. piling and for supporting the hammer during driving.



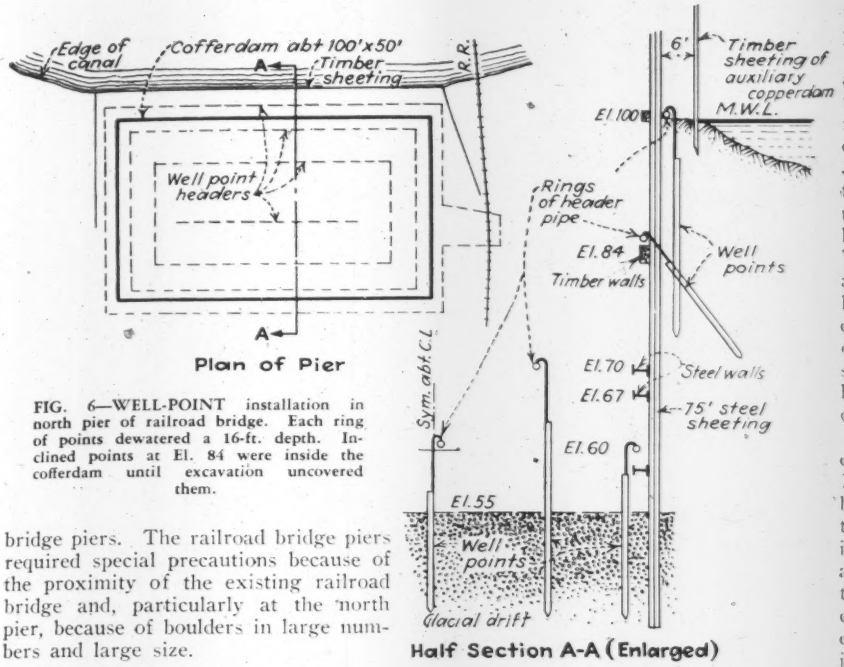


FIG. 6—WELL-POINT installation in north pier of railroad bridge. Each ring of points dewatered a 16-ft. depth. Inclined points at El. 84 were inside the cofferdam until excavation uncovered them.

bridge piers. The railroad bridge piers required special precautions because of the proximity of the existing railroad bridge and, particularly at the north pier, because of boulders in large numbers and large size.

Highway bridge piers

In sinking the south Sagamore pier, the perimeter excavation down to canal level was made to exact pier-base size, 108x50 ft., by means of power shovels. Two stiff-leg derricks were then set up, the top cofferdam bracing placed, and driving of the 65-ft. steel sheetpiling was immediately started. This sheeting of 16-in.-deep arch type, weighing 42.7 lb. per linear-ft. or 32 lb. per sq.ft., was to be driven to El. 39 (mean water level in the canal assumed at El. 100), thus placing its top at El. 104. The plan was to excavate with clamshells under water to El. 48 (the bottom of the pier), pumping out as required to install the two additional tiers of bracing, and then to pour a concrete seal under water to El. 73. The cofferdam would then be dewatered and the pier built in the dry.

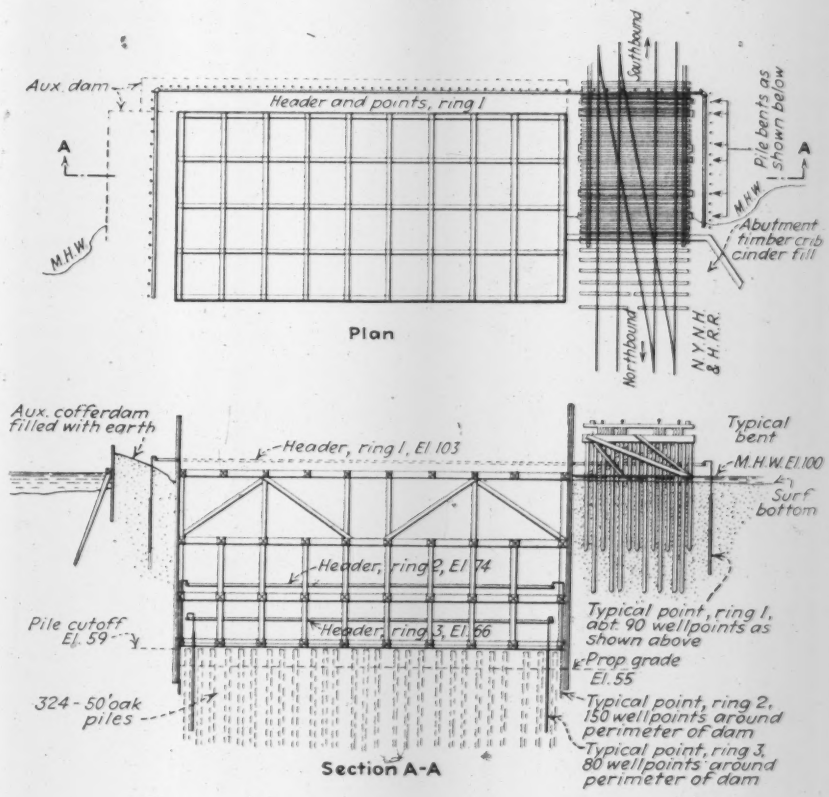
Difficulties in driving, however, began almost immediately, and boulders were encountered from El. 85 downward. Only about 60 per cent of the sheeting was driven to grade without difficulty on this pier. On the north piers at Sagamore and Bourne, conditions were somewhat better, about 80 per cent of the sheeting going down without much trouble. To remove the boulders under the 20 per cent of the sheetpiles that were hung up, it was found necessary to pump out the excavation. Since there were often ten or twelve consecutive sheetpiles that would not go down, pumping out was attended with great difficulty, and sump pumps finally had to give way to a ring of well points sunk just inside the cofferdam wall. By operating these well points at capacity it was possible to keep the water low enough to drill and shoot the boulders; and by keeping the bracing close to the ends of the sheeting and not very far above the excavation, it was possible to excavate to El. 60. In the end, five instead of three sets of bracing, as originally planned, were used.

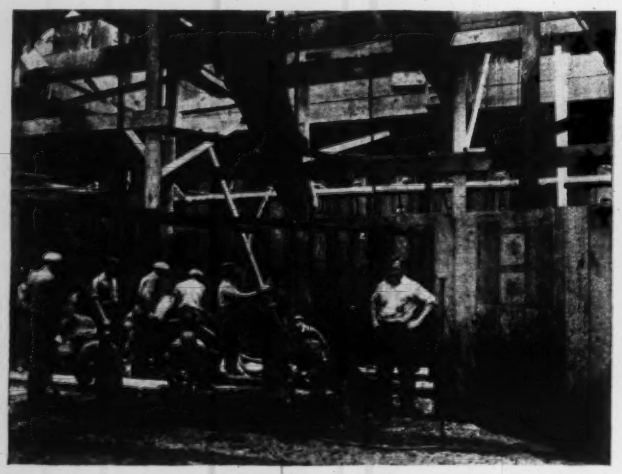
At El. 56 work had to stop because any attempt to dewater the hole caused the bottom to blow up. The government engineers then issued a change order requiring piles, and 560 oak piles 30 to 35 ft. long were driven from 22 to 27 ft. over the entire pier area, using 3½-ton and 5-ton steam hammers held in angle-iron leads under water. The piles were cut off by divers, using an airsaw suspended on a line, the length of which accurately fixed the cutoff elevation. These timber piles not only provided pier support in themselves but tended to consolidate the loose sand and increase its bearing capacity.

With the piles in place, a 21-ft. concrete seal was placed at a rate of about 133 cu.yd. per hour with submarine buckets. Although it had been planned to pull the steel sheeting, the change in plans which placed the pier bottom at El. 56 instead of El. 48 also required that the sheeting be left in as a precaution against scour if the canal should ever be deepened to 40 ft. Accordingly, the cofferdam sheeting was burned off at elevations varying from 20 to 30 ft. under water.

This south Sagamore pier was typical of the other highway bridge piers, except that south Bourne where, as previously stated, the rock and

FIG. 7—COFFERDAM FRAMING and well points in south main pier of railroad bridge. Pressures and water conditions were not as serious on this pier as on the north pier.





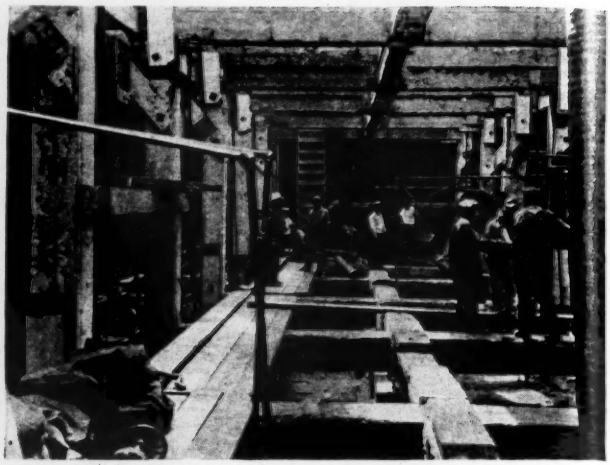


FIG. 8—HEAVY BRACING and unusually large installation of well-point piping and pumps characterized the Cape Cod Canal bridge-pier work, as shown by these views of the cofferdam for the north pier of the railroad bridge.

boulders were found to be extremely angular, and it was impossible to excavate with clamshells. Also at this pier the material at about El. 55 was considered good enough for a foundation without the use of piles. The excavation for this pier was done almost entirely by hand, a tedious and time-consuming operation. In general, sump pumps were adequate to keep the water down, although one set of well points was used.

The angular rocks, which fitted tightly together, were particularly resistant to piledriving. Sheetpiles were split and bent and twisted into incongruous shapes. One pile tip was found curled into a four-turn spiral around a small boulder. The toll in damaged sheeting was greater on this pier than on any other.

Hand excavation carried this pier to El. 63, after which it was flooded and excavated with the aid of buckets, jets and divers to El. 56, ready for the underwater seal.

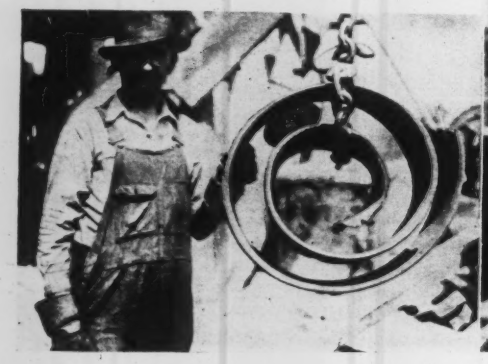
Railroad bridge foundations

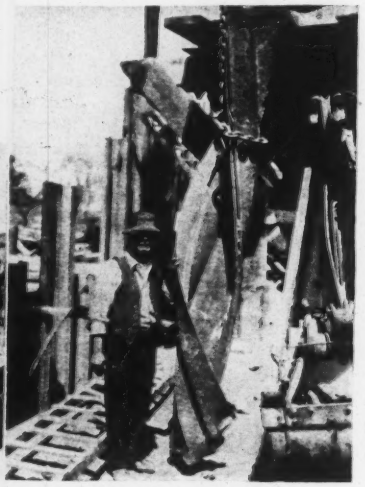
The cofferdams for the railroad bridge piers presented the most difficult and hazardous construction of the entire project. Work on these piers was done simultaneously with the others and thus could not benefit from previous experience. The existing railroad bridge and short approach trestles were immediately alongside the work. Water was present in greater quantities than elsewhere, and boulders were larger and more numerous. Only the north foundations will be described, as the south piers were similar and less difficult.

Work was begun on the north abutment, which is the foundation that will carry the back leg of the lift-bridge tower. It was soon apparent that solid bottom was not available. Sand boils appeared, and iron bars set in this material would drop out of sight. Test columns were put in and sunk quickly and steadily under a load of 2 tons per sq.ft. It was at this stage of the work that the decision to use wood bearing piles was made.

On the main or front tower leg pier, at the water's edge, the same conditions obtained and were accentuated by a higher hydrostatic head. It soon became apparent that the cofferdam could not be sunk by usual methods, the boulders being so numerous and so large that long lengths of the cofferdam pile walls were "hung up" a considerable distance above the bottom of the excavation. Any attempts to pump out, in order to remove these boulders, resulted in a blowing in under the walls.

FIG. 9—CURLED and twisted sheetpiling illustrates the difficult driving conditions that were met in sinking the cofferdams through the boulder-laden glacial drift.





Well points used

Under the circumstances, a study was made of possible means of dewatering the hole, and an elaborate well-point system was finally worked out which permitted the entire pier to be constructed in the dry. Four rings of well points were required, assuming that each ring would handle a depth of 16 ft.; later a fifth set was added at the elevation of the lower ring along the center line of the cofferdam (Fig. 6). Screens on the points were 4 in. in diameter, while pipe was 1¼ in. Header pipes were of 6-in. diameter. Rows of sheetpiling were first driven along the front (canal) face and the two sides of the cofferdam about 6 ft. from the cofferdam walls. In this 6-ft. strip the first ring of about 100 well points was installed, to dry out the top 16 ft. of the soil. When the excavation inside reached El. 84, the first set of well points installed inside the cofferdam was put in. Other sets were placed at El. 70 and 60, respectively. A total of 319 well points was used inside the cofferdam. When the excavation had reached about El. 70, the bottom of the well points whose tops were at El. 84 were exposed. In order to keep these points functioning, holes were cut in the cofferdam walls, and these points, pushed through these holes (Fig. 6) were able to draw water from the surrounding material between El. 84 and 70, relieving the outside hydrostatic pressure down to El. 70.

Four 8-in. and four 6-in. well-point pumps were required to operate this drainage system, two to each ring of points. In addition, there were two

stand-by pumps on the inside. These pumps were variously steam, gasoline and electric-motor operated. When excavation reached El. 84, the two pumps on the second ring of points were moved outside the cofferdam, but the others remained inside to the end of the work. In addition to the well points, two sump pumps were used, as required, to handle leakage through the steel sheeting below El. 70.

Excavation was by clamshell bucket. Boulders under the sheeting were drilled and shot with extreme care. Even with the drying out of the material by the well points, earth pressures remained high and extra bracing was required. The top frame of 16x16-in. bracing was at El. 100, and the next at El. 84. Both of these butted against timber wales. For the bracing at El. 70 and El. 61 steel I-section wales were used. An indication of the pressures being resisted occurred on several occasions when the webs of the I-beams buckled so completely that the two flanges were side by side.

A total of 324 oak piles was driven in this pier from El. 55. The jarring from this work caused unusual settlement of the entire area, the railroad trestle alongside sinking as much as 3 ft. and requiring continual shoring.

When the time came for pouring the pier base, some means was sought to salvage the well points that covered the bottom of the excavation. Since they could not be taken out of service until the seal was made, each was encased in a 6-in. pipe 15 ft. long, which was concreted in. The points were pulled through these pipes just before the last lift of concrete was poured in the base.

The bridges are being built by the Corps of Engineers under the direction of Lt.-Col. John J. Kingman, District Engineer, Boston. Designs and supervision of construction for the highway bridges were furnished by Fay, Spofford & Thorndike, of Boston, and for the railroad bridge by Parsons, Klapp, Brinckerhoff & Douglas and their associates, Waddell & Hardesty, of New York. The foundation work described was carried out by the Blakeslee-Rollins Corp., Boston, the contractor of record on the railroad bridge and subcontractor to the P. J. Carlin Construction Co., New York, on the highway bridges. The well-point installations were planned and their operation supervised by the Moretrench Corp., New York.

Column Base-Plate Design by Concrete-Beam Analogy

Easily applied to majority of buildings, the method, which takes wind moments into account, eliminates use of cubic equations except for certain rare cases

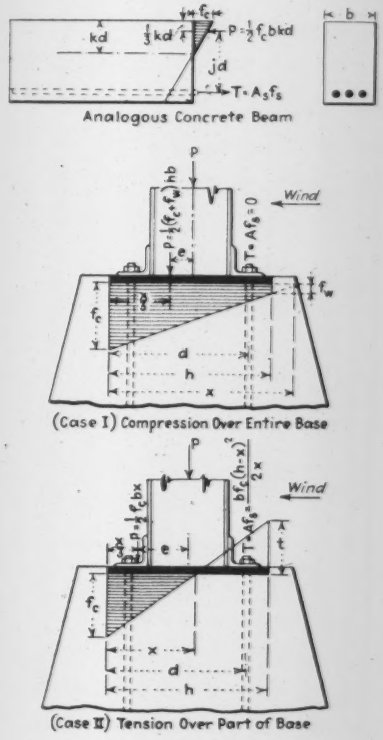
By J. E. Lothers

Associate Professor of Architecture, Oklahoma Agricultural and Mechanical College, Stillwater, Okla.

THERE SEEMS to be a scarcity of literature pertaining to column base plates that are subjected to bending, as from wind. Of the methods of analysis that have been published, most of them involving a cubic equation, no two seem to check in their results. This fact was lamented by Robins Fleming in his article in *Engineering News*, April 30, 1914, entitled "Anchor-bolt Tension: Six Different Results from Six Books," and again in *Engineering News-Record*, June 9, 1927, p. 941, "Proportioning Steel Slabs for Column Bases." Anchorbolts are usually designed to take the tension resulting from the wind moment divided by the distance from center of the windward bolts to the leeward edge of the base plate. This method does not take into consideration the fact that the tension in the bolts is a function of the relationship between wind moment and the direct load from the column, and sometimes, is in error on the side of weakness. Also, in most cases, the increased compression on the concrete footing under the leeward end of the base plate due to the wind is neglected.

Designing the base plate involves finding four things: (1) the area of base plate required to keep within the allowable compression on the concrete footing; (2) the necessary thickness of the base plate to resist bending due to the upward pressure of the footing; (3) the size of anchorbolts required to resist the tension on the windward side due to wind moment; and (4) the design of the anchorbolt-column connection to resist the wind moment. Item (2) is covered by the structural-steel handbooks and by Mr. Fleming's article (*ENR*, June 9, 1927). Item (4) is merely a matter of developing the tensile strength of the anchorbolts, the rivets through the column flange being in single shear. For finding the required area of the base plate and the anchorbolts the writer proposes a method of analysis, the simplicity of which should recommend it. It is based upon a reinforced-concrete beam analogy, as shown in the illustrations.

Just as the center of compression in the ordinary rectangular reinforced-concrete beam is assumed to be at the centroid of the triangular prism of compression at the top of the beam, so is the resultant load from the column assumed to be applied at the centroid of a triangular prism of pressure in the footing beneath the base plate. The altitude of this triangular prism is the width of the base plate, *b*. Its leg parallel to the assumed direction of the wind is denoted by *x* and is analogous to *kd* in the beam. Its other leg is at the leeward end of and perpendicular to the base plate. This leg is denoted by and equal in value to f_c, the allowable compressive stress in the concrete footing, the width of base plate being so chosen that this value is never exceeded.



BASE-PLATE ANALYSIS shown to be analagous to concrete-beam design by noting similarity between triangular prisms of compression at the top of a beam and in the footing beneath the base plate.

The windward anchorbolts are analogous to the tension steel in the beam and, to make the analogy perfect, the moment arm by which they are analyzed for tension would necessarily be $d-x/3$, to correspond with jd in the analogous concrete beam. Unfortunately, the analogy fails here, as will be shown

later. The leeward anchorbolts do not enter into the analysis, since the action of the wind tends to press the base plate down around them, resulting in a lessening of any initial tension that might exist in them.

In the analogous beam, kd is first computed, which determines the center of compression and, consequently, the effective depth of the beam or moment arm of the tension steel, jd. In the case of the base plate the center of compression is first located by computing the equivalent eccentricity e $(=M/P)$, and it is assumed that this resultant pressure, as in the case of the beam, passes through the centroid of the triangular prism of compression in the concrete under the base plate. The value of x (corresponding to kd in the beam) then follows directly.

There are three cases to consider. Case I will designate the condition in which there is compression over the entire base—i.e., in which x is greater than h, the length of the base plate. The pressure on the concrete for this case is represented by a trapezoid, as shown. Case II will designate the condition in which there is tension under a portion of the base plate and in which e is less than $h/2$. In this case, x is less than h, and the compression under the base plate is represented by a triangle. Case III applies to the condition in which the moment is so great in comparison to the direct load from the column that the resultant load falls outside the column base. In the extreme case there might be tension over the entire base.

Compression on entire base

For Case I, let P be the axial load brought to the base plate, in lb., and M the wind moment in in.-lb. Also, let e be the equivalent eccentricity of the resultant load. By equivalent eccentricity is meant the distance from the center of the column that P would have to be applied to produce M if M were caused by eccentric loading instead of by the wind. Then since e would have to be such that $Pe = M$,

$$e = M/P \qquad (1)$$

The length, h, of the base plate must first be assumed and later revised if necessary. The resultant load must pass through the centroid of the triangular prism of pressure in the footing. In this case the triangular prism extends beyond the windward end of the base plate as shown. Since e measures the distance to the point of application of the resultant load, then $e + x/3 = \frac{1}{2}h$, so that

$$x = 3(\tfrac{1}{2}h - e) \qquad (2)$$

The load, P, from the column is represented by the volume of the trapezoidal prism of pressure under the base plate (shown shaded). Use is made of this fact to find the width, b, of the base plate. Let f_c equal the allowable stress under the leeward end of the base plate and f_w the corresponding stress under the windward end. Since x is known, the value of f_w may be obtained by similar triangles. The volume of this trapezoidal prism equals $\frac{1}{2}(f_w + f_c)\,hb$, and since it represents P, then,

$$b = \frac{2P}{(f_w + f_c)\,h} \qquad (3)$$

This value of b corresponds to the assumed or tentative value of h, and if there is not a reasonable relation between the two, a new value of h must be assumed and the above process repeated until a desired ratio between b and h has been found.

In Case I there will be no tension in the anchorbolts for the design wind load, except possibly during the process of construction. A nominal size of anchorbolt is chosen, therefore, in accordance with good practice; or a design may be made on the assumption that the windward anchorbolt resists the wind moment with a moment arm equal to d.

Practically all tall buildings will fall under Case I.

When tension is present

For Case II, when the wind moment M is comparatively large, a correspondingly large value of e results, and a value for x is obtained that is less than h. This indicates tension under a part of the base plate and, of course, tension in the windward anchorbolts. Eq. (2) for x under Case I holds also for Case II. Since x is less than h, the load P is represented by the volume of a triangular prism of pressure in the footing (shown shaded). Therefore, $P = \frac{1}{2}bf_c x$, from which, for Case II:

$$b = \frac{2P}{xf_c} \qquad (4)$$

The area A of the anchorbolts may now be obtained. When, as in Case II, x is less than h, there will be a triangular prism of tension under the windward end of the base plate. It is assumed that this triangular prism represents the total tension in the windward anchorbolts, just as the prism of pressure at the other end represents P. Let the volume of the tension prism be denoted by T and the leg of the tension triangle (triangular base of the tension prism) perpendicular to the base plate by t. Then,

$$T = \frac{bt(h - x)}{2} \qquad (5)$$

But from similar triangles, $t = f_c(h\text{-}x)/x$.

Therefore,

$$T = \frac{bf_c(h - x)^2}{2x} \qquad (6)$$

Finally, if f_s is the allowable stress in the windward anchorbolts, then,

$$A = \frac{T}{f_s} = \frac{bf_c(h - x)^2}{2f_s x} \qquad (7)$$

To extend the beam analogy to include the windward anchorbolts would mean basing their design upon the equation $M = Af_s(d\text{-}x/3)$. Since $d\text{-}x/3$ is the distance from the center of windward anchorbolts to the center of compression, and since this distance is proportional to M/P, it is evident that values of A that are inversely proportional to the amount of tension T would result. Hence the beam analogy fails as applied to the design of the anchorbolts.

Eq. (4) and (7) give results that are in error on the side of safety. As x approaches h, the error approaches zero and is negligible, beginning with $x = 0.8h$. As e approaches $\frac{1}{2}h$, however, the error becomes so great as to render this method inapplicable. For such cases, the reader is referred to a cubic-equation method of analysis given in *Engineering Record*, Oct. 17, 1914. As already mentioned, however, the ratios of M to P found in practice are such that a case to which the proposed method does not apply is very rare. The writer has designed base plates by the proposed method for six different sets of data falling under Case II and checked the results by means of the *Engineering Record* method with complete satisfaction.

Abnormally high wind moment

For Case III, when the wind moment is very large in comparison to P and, in addition, a large proportion of the direct load is eccentric, such as the load from a crane in mill construction, a value of e that exceeds $\frac{1}{2}h$ may result. The resultant load then falls outside the base plate and the proposed method of analysis does not apply. This case rarely occurs in practice.

While the proposed method of analysis does not apply to Case III, the *Engineering Record* method, on the other hand, does not apply to Case I, since it presupposes tension in the windward anchorbolts and that this tension enters into two terms of the cubic equation.

The writer, therefore, recommends that the proposed method of analysis be used for all designs falling under Case I and for such that fall within Case II with a ratio of x to h lying between two-thirds and unity. The *Engineering Record* method is recommended for those falling under Case III and those falling under Case II to which the proposed method is not applicable.

In conclusion, it might be mentioned that the proposed method of analysis provides a quick way of getting a preliminary design for that part of Case II to which it is necessary to apply the *Engineering Record* method. Remembering that the proposed method gives values in error on the side of safety, allowance therefore may be made in setting up the cubic equation.

Well-Equipped Road Work in Connecticut

Eleven-mile bituminous macadam trunk-line road in hilly country brings out full line of grading and surfacing equipment, to meet rigid specifications

FIG. 1—STONE CHIPS to cover penetration charge and seal coat were spread by hand on bituminous-macadam primary road from Preston to the Rhode Island line.

A HIGH-TYPE bituminous macadam road, 11½ miles long, now approaching completion, will open up a new fully improved Connecticut trunk-line road to the Rhode Island boundary and the city of Providence. In construction this road is an example of about as modern practice as bituminous roadbuilding of the present time can show. As a traffic improvement the new road provides a much shorter line east to Rhode Island from the industrial center of Norwich located at the navigable head of the Thames River in Connecticut. This article is primarily an account of grading and paving methods and equipment on the new road.

As shown by the small-scale map (Fig. 2), an improved road (Route 165) existed from Norwich to Preston, and from there to Voluntown this route and route 138 from Voluntown to the Rhode Island boundary were unimproved earth roads. In planning improvement it was logical to follow in general the line of the old road, preserving existing route assets but correcting the faults of narrow width and frequent kinks in detail alignment. The notable feature of this relocation is the degree to which a good alignment was secured without departing widely from the old route. Crooks in the old road submitted surprisingly to replacement by long tangents and long flat curves. In general, this is indicated by the larger scale map (Fig. 2), but the figures are a more positive demonstration. The total route length of 60,400 ft. is nearly 60 per cent tangent and 40 per cent curve. Of the eighteen curves, two having a total arc length of 1,366 ft. are 5 deg., one having an arc length of 1,500 ft. is 4 deg., and the other fifteen curves (totaling about 21,000 ft. of arc) range from 0 deg. 30 min. to 3 deg. 30 min. and are usually not sharper than 2 deg. In general, an easy high-speed line replaced the old crooked road.

In the rough country of eastern Connecticut a profile of continuous rolling grades was necessary to keep grading volumes down. In the profile adopted, cuts and fills were made to balance with reasonable maximum hauls, using grades up to 7 per cent. For the line as a whole the excavation, allowing for 15 per cent shrinkage of earth, was about 205,000 cu.yd. to balance about 212,000 cu.yd. of fill, leaving about 8,000 cu.yd. of borrow excavation, including 15 per cent for shrinkage.

The road structure adopted followed closely Connecticut highway department practice for bituminous macadam. A typical section is shown by Fig. 3. The essential items not indicated by the drawing are: base course, native 3-in. stone, with a limit of wear of 5.5; wearing course, 2-in. traprock with a limit of wear of 3.3; oil-treated gravel shoulders and bituminous surfaced gutters in cuts of a grade of 4 per cent or greater. A 24-in. gravel sub-base is used in rock cuts; at other locations where conditions warrant, a 12-gravel sub-base is used. About 33,000 cu.yd. of gravel-fill sub-base was used.

With about 243,000 cu.yd. of material, including borrow, to be moved from cut into fill, the grading ran about 21,000 cu.yd. a mile. Of the 235,000 cu.yd. gross of cut excavation about 35,000 cu.yd., including 20,000 cu.yd. of boulders, was classed as rock. In all about a third of the excavation was earth and about two-thirds were earth and boulders or ledge rock. This made a heavy grading operation, and the contractor installed a notably large grading plant, shown by the accompanying

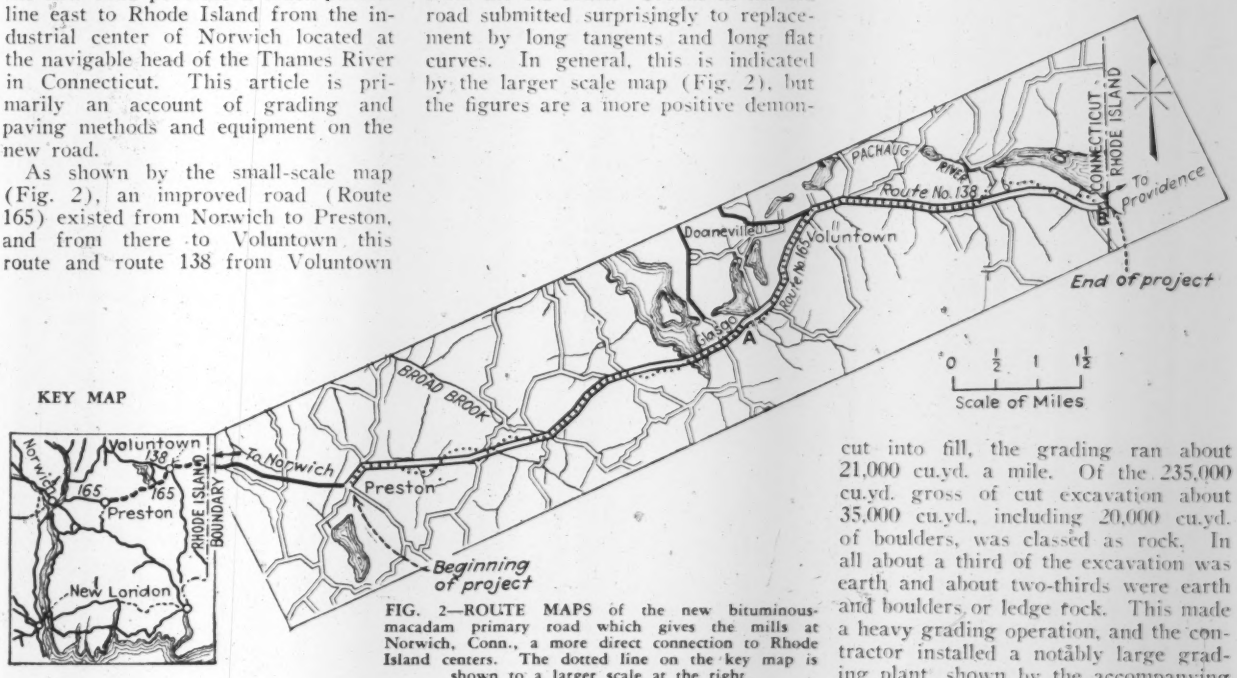


FIG. 2—ROUTE MAPS of the new bituminous-macadam primary road which gives the mills at Norwich, Conn., a more direct connection to Rhode Island centers. The dotted line on the key map is shown to a larger scale at the right.

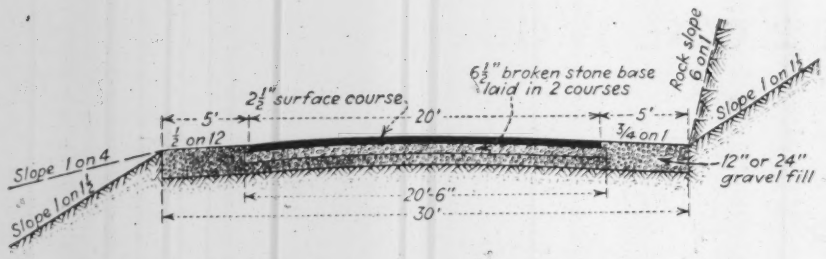


FIG. 3—ROAD CROSS-SECTION for new bituminous-macadam trunk highway west from Norwich, Conn.

table of principal equipment units. In this list the crushing plants were installed to provide crushed stone for the macadam base course from rock excavated at two locations in the grading operations and quarried from a ledge of gabbro located about 2 miles south of the center of the project.

GRADING EQUIPMENT ON THE PRESTON-RHODE ISLAND ROAD IN CONNECTICUT

1 1½-cu.yd. power shovel
2 7/8-cu.yd. power shovels
1 1¼-cu.yd. power shovel
3 1-cu.yd. power shovels
1 ½-cu.yd. power shovel
1 Crawler crane
2 12-cu.yd. carryall scrapers
2 75-hp. crawler tractors
10 Bulldozers
2 500-ton, diesel electric crushing plants
2 Wagon drills
8 Portable air compressors
2 Diesel tractor trucks

Power shovels and trucks handled about 70 per cent of the excavation; they were assisted on fills by bulldozers and in ledge excavation by well drills. These were familiar procedures, but the introduction of two 12-cu.yd. carryall scrapers presented an uncommon feature. About 70,000 cu.yd. were moved by the carryalls, mostly where the earth had few boulders and the cuts and fills were close and fairly well balanced. It was found that they were economical up to about a half-mile haul, but beyond this distance power shovels and trucks were superior.

The carryall scraper is yet a novelty on road grading in the eastern United States. It was introduced this year on the light soil-grading operations of the Boston-Concord trunk road (*ENR*, Nov. 8, 1934, p. 590) and somewhat earlier in the season on the work being described. In both cases two outfits closely similar were adopted. The views (Figs. 4, 5 and 7) show a carryall scraper outfit in characteristic operations.

As shown by the illustrations, a scraper and a tractor made up a carryall working unit. For a 12-yd. scraper a 75-hp. tractor was used. The scraper unit, weighing about 7½ tons unloaded, was described in the above article on the Boston-Concord road. Substantially it is a sublimated wheel scraper, power-operated (for digging, riding clear and unloading) from the tractor. However, instead of unloading by tilting, the load is pulled out of the front end of the scraper, riding clear by pulling forward a sliding tailboard. By this unloading process the material is discharged in a layer not thicker than the clearance height of the scraper body, which is about 6 in. All operations are controlled by the tractor operator.

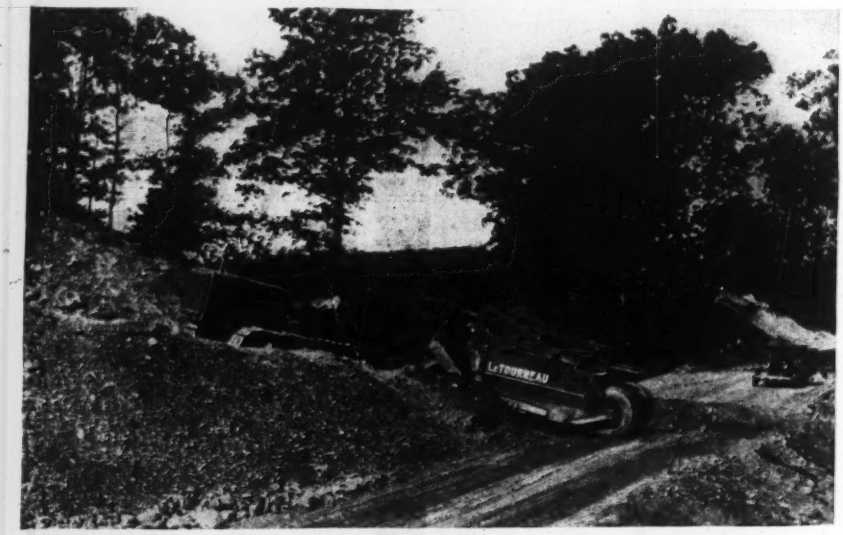


FIG. 4—SHORT TURN of 90 deg. and sharper taken regularly by tractor-carryall scraper in maneuvering into cuts and off fills.

FIG. 5—CARRYALL SCRAPER cutting down bank by succession of thin cuts and hauling 12-cu.yd. load to fill.

As a device for making cuts, the scraper had the merit of leaving well-formed slopes. By beginning to dig at the outer edge of the slope and gradually stepping in the travel of the scraper as depth of cut was attained, the sides of the cut were given a rough slope that was quite true and so reduced slope trimming. In fills the scraper spread its load in layers that were well compacted by the tractor crawlers and the six 13½-in. pneumatic tires of the scraper carriage.

Figs. 4, 5 and 7 indicate both the sloping and compacting actions described. Referring to the illustrations more particularly, Fig. 4 shows the scraper unit making a sharp turn onto a bank which it is cutting down. In Fig. 5 the scraper higher up on the bank is taking on load by a thin scrap-

ing cut. Fig. 7 shows a completed rough grade (note slopes of cuts and compaction of grade) with the scraper empty and returning at 5 miles an hour for another load. With a 12-yd. load the unit traveled back over this grade at between 2 and 3 miles an hour.

Pavement construction

Pavement construction conformed to the strict Connecticut specifications for bituminous macadam. This included particular care in construction methods as well as use of the choice materials already described. The sub-base gravel was a bank-run material required to be not over 50 per cent passing a ¼-in.-square opening, the rest graded from ¼ in. to 5 in. rolled in layers and with the top finished exactly to profiles parallel with the surface profiles of the pavement. Stone for the base was produced from native rock by the two 500-ton, diesel-electric crushing plants erected on the job. The base was placed in two equal layers rolled by 10-ton rollers, each course filled with stone dust or sand filler and bound with water. After thoroughly sweeping the prepared base course of surplus filler, the traprock wearing course was spread and rolled sufficiently to obtain a mechanical bond between the particles of stone.

In general characteristics the processes described are those of any bituminous paving, their distinctiveness in Connecticut practice being their careful performance. As in his grading the contractor fully mechanized the surfacing operations. Besides the large crushing plants the work was equipped with trucks, stone spreaders, pressure asphalt distributors, rollers and the usual supplementary equipment for bituminous macadam construction. Spreading filler and sweeping were done by hand. These operations are indicated in Figs. 1 and 6.

Application of the asphalt requires notice mainly for the care taken to insure even distribution and penetration. An 85-100 penetration asphalt was used in two applications: first, 1¾ gal. per square yard covered with ¾-in. traprock chips bound and rolled; and second, a seal coat of 3.4 gal. per yard covered with ½-in. chips and again broomed and rolled. Even distribution was secured by control of distributor pressure, asphalt temperature and tachometer regulation of rate of flow. Where possible the full 20-ft. width was sprayed in one operation, to prevent any overlap along the middle of the road. In starting an application from a surface already penetrated the old surface

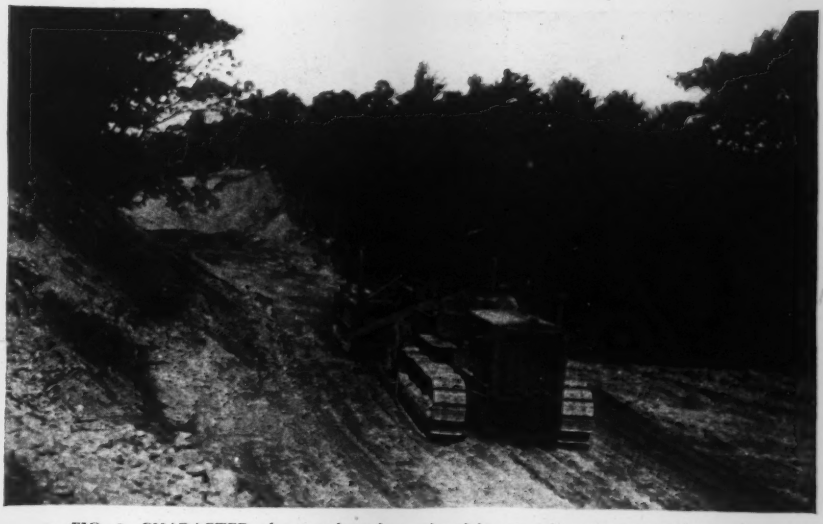


FIG. 7—CHARACTER of cut and grade produced by carryall scrapers; crawlers and six 13½-in. pneumatic tires produce firm compaction.

FIG. 8—GUTTER in cuts formed by extending stone into ditch and a short distance up the bank, penetrating it with asphalt.

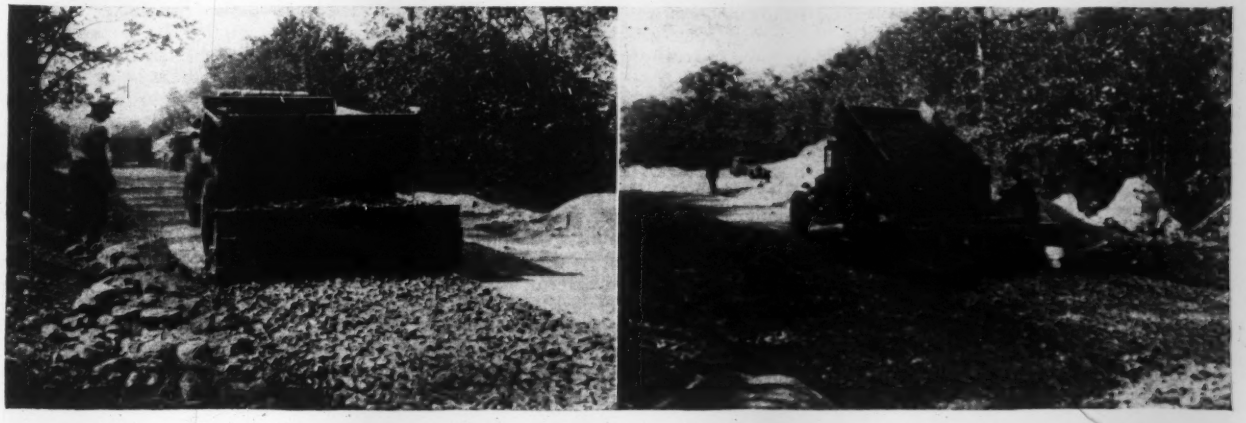


FIG. 6—STONE SPREADERS of two types spread base and wearing-surface stone for Preston-Rhode Island road.

FIG. 9—SPRAYING GUTTERS from pressure-tank truck by hose and hand-operated nozzle.

was shielded from the spray to prevent overlap and a consequent fat strip across the road.

As indicated previously, the 5-ft. shoulders were oiled and in cuts on a 4 per cent grade or greater, forming a gutter as shown by Fig. 8. This slopes away from the edge of pavement of the rock of ¾ in. per foot for a distance of 5 ft., and then rises 6 in. in 12 in. against the slope. The penetration of gutters was performed by the contractor's forces, using the equipment shown in Fig. 9.

Managing labor

As an NRA operation the construction presented a problem in handling labor which, while largely dictated by local conditions, had general characteristics. Common labor was limited to 30 hours per man per week and had to be recruited from official labor-relief bureaus. The contractor adopted the plan of starting the worker Thursday morning and working him a full ten-hour day for the three days of that week and the three first working days of the next week. Then his place was taken by another worker for the following six working days. Each man thus worked a full week every other week.

This work schedule was adopted to meet local conditions. The work was located in a sparsely populated country region, and as most of the available workers came from towns at some distance, they had to board at farm houses along the road or drive from and to their homes. By working alternate weeks, living and travel expenses were reduced.

Most interest, however, lies in the character of the labor. When the work was in full swing the daily shift averaged 275 men, with a peak force of 374 men. The turnover was large. A large proportion of the workers sent out from the unemployment-relief agencies were youths just out of school who had never worked. Others from the textile mills and other industrial plants at Norwich had had no construction experience. A third group were men from the Civilian Conservation Corps, and they were found to be in good health and physically hardened to manual labor. Most of the textile mill workers could not stand the conditions and dropped out of the ranks after a few days. To obtain a working force of 500, about 1,900 applicants had to be examined and given trial. Every day an excess of eight or nine men, to fill vacancies caused by sudden defections, were on the payroll.

A practice found profitable by the contractor was to have his own doctor pass on the applicants. In this way men physically unfit for roadwork were barred and injuries reduced. The necessity of trial presented difficulty, particularly in the case of machine operations; a pretended machine operator could often do much damage before he could be discharged.

Direction

The construction described was under the direction of the Connecticut highway commission, John A. Macdonald, commissioner. The contractor was the Lane Construction Co., Meriden, Conn.

Construction Accidents and Compensation Insurance Rates

Annual cost of workmen's compensation awards is reaching a staggering figure—Rising insurance rates can be checked by accident control—Planning an accident-prevention program

By E. N. Goldstine
Safety Engineer, State Compensation Insurance Fund of California, San Francisco, Calif.

THE construction industry paid more than $60,000,000 for workmen's compensation insurance premiums in 1929. Since that time the rates in general have been increasing, until today the average is between $6 and $7 for every $100 of payroll. Progressive contractors realize the increasing burden that these rising rates are placing upon the construction industry and the effect on construction costs, and are making serious efforts to keep insurance costs at a minimum. With existing compensation laws remaining in force, the only practical way to lower insurance expense is to reduce the number of accidents.

There are no mysteries in the establishment of workmen's compensation insurance rates. Detailed statistics are gathered annually by the National Council on Compensation Insurance concerning the amount of payroll, premium volume, number of compensable injuries, medical expense, compensation payments and other pertinent data for every classification in the Compensation Manual for each of 34 states and the District of Columbia. Five years' experience is combined and analyzed on each individual rate. From all these figures statisticians recommend what rates are required to provide sufficient income for the losses that are likely to be incurred, as judged from the past record, and to this is added an allowance for the expense of administration and the cost of acquiring business. The rates finally promulgated are usually reasonably close to these recommendations, being somewhat modified occasionally by the judgment of insurance commissioners and rating bureau committees in different states.

A few representative classification figures are given in Table I. They have been compiled from the records of 34 states and the District of Columbia for the year 1929, these being the latest available national figures, all losses being modified to give figures that would be required for compliance with the laws of New York State as of Oct. 1, 1927. The medical expense and compensation award figures represent the direct outlay for medical care and compensation payments to the injured without including any expense items of the insurance carrier. The pure premium is the rate required per $100 of payroll for medical expense and compensation award, with nothing else included. The manual rate, which is the amount

charged by the insurance carrier, is intended to provide for the losses incurred and the expense of operating the insurance business. This basic rate (ignoring certain refined statistical calculations) is determined by dividing the pure premium figures by 0.594, as it has been learned over a long term of years that out of every dollar paid insurance carriers, 59.4c. is required to pay losses, while a loading of 40.6c. covers administration and acquisition expense.

TABLE I—A FEW REPRESENTATIVE CLASSIFICATION FIGURES FOR 34 STATES, 1929

Classification	Payroll	Medical Expense and Compensation Payments	Pure Premium	Manual Rate
Excavation, bridges and buildings	$24,126,500	$1,143,744	$4.74	$7.95
Steel erection, buildings	7,280,200	961,958	13.22	22.20
Concrete construction	96,100,800	4,364,896	4.54	7.60
Carpentry, interior trim	25,460,300	321,464	1.26	2.12
Carpentry, not otherwise classified	87,349,700	3,410,760	3.90	6.54

The complete summary of experience surveyed for a single year showed total payrolls of $1,377,426,000 attended by 3,292 serious cases (compensation awards in excess of $1,250 each, which included 1,128 fatalities, 103 permanent total disabilities, with a loss of $17,443,080); 84,505 so-called non-serious cases resulting in more than six days of lost time with compensation awards of $19,470,640; medical costs of $9,116,520 making the total of incurred losses for the year 1929 for the United States, exclusive of fourteen states, amount to $44,030,240. All calculations of losses are on New York State award levels. With a single manual rate for the entire construction industry, the figure would be $5.61 per $100 of payroll.

The extent of all the losses in comparison with the premium received in any given rate classification is the primary condition determining the broad level of manual rates. The function of insurance is simply to serve as a means of distributing the losses of all policy holders in an equitable manner. Unless and until these loss rates are substantially reduced, there can be no hope for any appreciable modification of the pure premium figures that form the basis of the rate structure.

Experience affects rates

The insurance rate of the individual contractor in some states is affected by a factor known as experience modification. It is calculated on the principle that the hazard is to some extent measured by the past experience of each individual risk and is a method of measuring the variation from the carefully constructed manual rate. Even in the same rating classification, different contractors develop different accident frequency and severity rates due to varying circumstances, such as differences in plant and equipment, in methods, in morale and job discipline, safety instruction, and the permanence, intelligence and industrial training of the working force. Through the involved rating procedure of the experience modification plan, based on sound statistical insurance principles, it is possible for a contractor with good experience to have his insurance costs very substantially reduced. One large contractor, as an illustration, has a modification of 65 per cent of the manual rate, due to the exceptionally fine consistently good loss ratio (the percentage obtained by dividing the annual losses incurred for the policy year by the premium for the same term). On the other hand, some companies are penalized by an experience modification of 175 per cent and more, due to invariably bad experience, frequently and usually associated with complete indifference to approved and proven accident-prevention procedure. In the case of one organization, the direct insurance loss due to the debit rating amounted to an excess of $10,000 a year over the manual rate figures.

What can be done to improve the insurance situation? The answer is provided by the experience of many individual firms and whole industries throughout the United States. The portland cement industry, for example, has developed a remarkable safety record in recent years through intelligently directed and controlled accident-prevention effort. Many contracting firms have found it possible to reduce accidents as much as 50 per cent below the average, with consequent attendant savings that repaid them for their exertions many times over. The U. S. Engineer Department recently reported that 47 out of 61 units operated a year or more without a lost-time accident, having a total exposure of 3,200,000 man-hours. Normal experience on engineering construction for this amount of work would customarily result in two fatalities, seven permanent disabilities and 151 injury cases, each averaging a month of lost time.

Accident causes and cures

One or more basic causes exist for every accident, any one of which properly disposed of would have prevented the mishap. The problem of accident control resolves itself into analyzing these causes competently, prescribing the proper remedy, and then following through to see that the right medicine is taken and the cure effected. Organizations that are fully safety conscious have relatively few accidents, for they have learned how to prevent them. Every construction organization can and should learn to do the same thing.

Before the causes of accidents can be analyzed, they must be determined and classified. Table II shows a classification of general causes of construction accidents reported by one state for a certain length of time, and subclassification of one of the basic causes is shown in Table III. Every one of the other basic causes can be split into similar subclassifications. General accident-cause classifications will serve in a broad analysis of construction-accident causes, but obviously a specific analysis of a contractor's own accidents can be made only from proper classification of causes of injuries on his own work. The proper recording of accidents and intelligent interpretation of the records are fundamental in planning an accident-prevention program.

As contractors learn to have such figures compiled from their own organization experience, which may vary appreciably from the average of the industry, they can then plan a program for accident prevention which will fit their particular needs. If nail punctures, falls and falling objects appear frequently as causes of injury, detailed accident reports supplemented by intelligent investigation will indicate the need for better housekeeping, safe scaffolds, and proper piling and handling of material. Similarly, other causes will point out clearly the remedies required to avoid such accidents.

TABLE II—CLASSIFICATION OF GENERAL CAUSES OF CONSTRUCTION ACCIDENTS REPORTED BY ONE STATE

Cause	Per Cent of Total Accidents
Misc. and indefinite	3
Harmful substances (cement burns, etc.)	2
Electricity, explosives, heat, etc.	3
Elevators, hoists, conveyors	4
Machinery, prime movers, etc.	5
Vehicles	5
Stepping on and striking objects	6
Using hand tools	8
Falls of workers—on same level	9
Falls of workers—to lower levels	16
Falling objects	11
Handling objects	28
	100

TABLE III—SUB-CLASSIFICATION OF ACCIDENTS CAUSED BY HANDLING OBJECTS

Cause	Per Cent of Total Accidents	
Object dropped while handling	18	
Object dropped while loading	8	
Object dropped while piling	1	
Object handled by fellow worker	2	
Caught between object handled and another	6	
Object slipping or breaking	7	
Strain in handling object	26	
Total for handling heavy and bulky objects		68
Blisters, friction burns, etc.		2
Handling carts, wheelbarrows, etc.		6
Wood slivers		4
Handling sharp or rough objects		20
Total		100

A genuine safety program designed for results in a construction organization might well include these recommendations:

1. Safety publicity that will inform the entire organization what to do to prevent accidents. Safety posters, special bulletins, safety magazines, and an employee publication are all desirable. The National Safety Council at Chicago

can supply some of this necessary material.

2. The maintenance of all tools, machinery, scaffolds, working places, etc., in a safe condition. A brief daily inspection by an intelligent and interested workman or timekeeper assigned to this task will make for a big improvement on most jobs, if the proper attention is given to what can be readily observed.

3. The superintendent, foreman and timekeeper should constitute a permanent safety committee, perhaps supplemented by some of the workmen, who would constantly be on the lookout for opportunities to correct improper working methods.

4. All foremen, and as many workmen as possible, should be well trained in first aid, preferably in the U. S. Bureau of Mines first-aid course. Suitable first-aid materials should be on the job, to be applied by a person qualified in first aid.

5. A practical and well-informed safety engineer should visit the work and size up the entire situation occasionally, and should analyze the accident experience. From the facts obtained, definite and suitable recommendations should be deduced and carried out by the contracting organization.

6. Every new employee should be instructed in the proper and best way to do his job, with special emphasis on the hazards of various tasks and the way to avoid or minimize them.

7. A responsible executive of the company should consider accident prevention as seriously and as frequently as any other business problem of equal financial importance. Many firms might readily save thousands of dollars every year in their insurance costs through utilizing proper safety procedures. Consequently, the time and ability devoted to the subject should be of a caliber competent to deal with it capably. The literature on safety should be freely consulted and put to practical use.

Results obtained

The adoption of this seven-point program in one organization resulted in a reduction of 50 per cent in accident frequency and severity during the first year. Other illustrations of a similar nature might be cited, though perhaps not quite so outstanding, principally because the efforts made were not as sincere or extensive.

It remains for the construction industry, through its individual members as well as collectively, to determine what results should be accomplished in reducing the burden of insurance costs through preventing injuries to their workers. Any reasonable goal can be achieved just as rapidly as the appropriate accident-prevention technique is properly appreciated and actually put into effective practice.

Four Long Trestles Cross Bonnet Carré Spillway

Mississippi flood-relief channel spanned by three railway trestles of timber, steel and concrete and a highway trestle of concrete—Piles 75 to 90 ft. long in deep wet soil—Firestops in timber trestles

By E. E. R. Tratman
Wheaton, Ill.

UNUSUAL combinations of timber, steel and concrete construction characterize three long railway trestles crossing the Bonnet Carré spillway channel about 22 miles above New Orleans, while a fourth crossing, for a new state highway, is a typical concrete trestle. The situation is indicated in Fig. 1.

This channel, designed to divert 250,000 sec.-ft. of floodwater from the Mississippi River into Lake Pontchartrain, and so prevent excessive flood levels at New Orleans, has a width of 1½ to 2½ miles between guide levees 12 to 20 ft. high. Its length is about 5½ miles. At its upper end is the spillway structure, 7,700 ft. long, forming a part of the river levee and consisting of a low concrete dam with half its crest at El. 18 and the other half at El. 16. This is surmounted by 12-in. needle timbers whose heads are at El. 28. These timbers are seated in pockets in the concrete, and their upper ends rest against a line of I-beams carried by piers on the dam. For flood relief these timbers can be removed by a derrick traveling on a bridge carried by the piers. The flood level at the spillway is estimated at El. 24.

Two of the railroad crossings are for the Illinois Central Railroad System. At the lake or discharge end of the channel is the double-track main line, while 4½ miles above it is the single-track main line of the Yazoo & Mississippi Railroad, a subsidiary of the Illinois Central System. Between them are the crossings of the Louisiana & Arkansas Railroad and the new Louisiana state highway, as shown in Fig. 1. Owing to the levees along the channel and to the estimated floodwater depths of 10 to 14 ft., the three railways had to be raised above their original level, the crossings being approached by grades of 0.5 per cent. This raise is 12 ft. for the Illinois Central, 16 ft. for the Yazoo & Mississippi Valley, and 20 ft. for the Louisiana & Arkansas Railway. The new highway crossing is also built above its normal level outside the channel.

Three of the four trestles are shorter than the width of spillway, having approach embankments within the levees that mark the channel. Thus the highway trestle and that of the Yazoo & Mississippi Valley line are supplemented by 4,300 ft. and 1,100 ft. of fill. This arrangement was approved by the U. S. Engineers, as after the construction of the spillway it was determined that the floodflow would not have sufficient velocity to cause erosion within the narrowed waterway at the crossings. It was held that a sufficient length of structure would be 6,000 ft. for the highway, 8,000 ft. for the Illinois Central Railroad and 5,005 ft. for the Yazoo & Mississippi Valley Railroad. However, the railways did not agree with this and built structures of greater length, that of the Louisiana & Arkansas Railroad extending the full width between levees.

FIG. 1—FOUR long trestles cross Bonnet Carré spillway about 22 miles upstream from New Orleans.

For railroad structures of such length and under such conditions, pile and timber-trestle construction was considered to be the most suitable and economical, but the great length made it imperative that any fire hazard would be localized. This requirement was handled in different ways by the railways. For the highway, the length of trestle was shortened by earthfill approaches, so that a concrete-pile trestle was economical.

Foundation conditions at all sites are very unfavorable, the ground surface being only 1 to 5 ft. above sea level, except that near the river it rises to

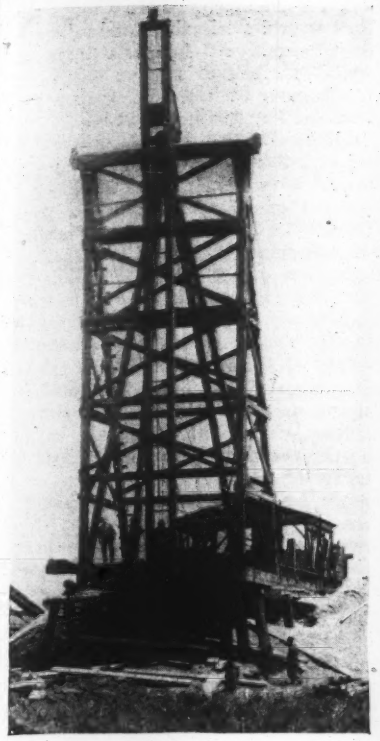


FIG. 2—DOUBLE-TRACK piledriver used on I.C.R.R. trestle has traversing leads for twelve-pile bents.

about 12 ft. The formation is principally an alluvial soil of such depth as to preclude any attempt to reach a solid stratum. Very long friction piles were required for such conditions.

Illinois Central trestles

For the double-track main line, noted above, the structure is 11,749 ft. long and has at each end a short fill within the channel, the distance between the center lines of the guide levees being nearly 12,000 ft. The railroad's standard pile trestle design is used, Figs. 2 and 3, having spans or panels 13 ft. c. to c. of pile bents and carrying a ballasted deck. There are 24 groups or sections of such trestle, each consisting of 26 to 40 spans and totaling 862 spans. Each group is separated from the next one, either by a concrete pier or fire wall, or by an intermediate steel I-beam deck span or a through plate-girder span on concrete piers. Thus in the length of the structure there are thirteen firestop piers, five I-beam spans and five girder spans. The grade line, or base of rail, is at El. 19.25, or about 18 ft. above ground level and 7 ft. above the estimated maximum flood level at this end of the spillway.

Timber Pile-Trestle—In the standard design of double-track ballasted-deck trestle (Fig. 3), each bent consists of twelve piles. The bent has swaybracing on each side and a horizontal or collar brace as close to the ground as convenient. Two caps, 14x14 in. and 14 ft. long, are spliced at the center line. On the caps rest stringers 7x16 in., 14 ft. long and spaced 7½ in. apart, each span having 23 stringers. These are covered by a deck of transverse planks 3x8 in., alternating 12 and 14 ft. in length. Along the edges of the deck are curbs or guard timbers 8x8 in. bolted through the stringers and caps. Screened slag ballast is 6 in. deep under the 6-in. ties and is dressed level with the tops of the ties and the guard timbers.

Hand-car refuges provided at intervals consist of 22-ft. caps on two adjacent bents and projecting on one side of the trestle, these caps carrying 3x10-in. joists with a platform of 3x8-in. planks laid longitudinally and covered with 3 in. of ballast. At intervals also are water barrels for fire protection, each carried on a platform supported by 3x10-in. planks 6 ft. long bolted to both sides of a cap. The barrel is secured by stay rods hooked over its top edge and passing through the platform planks, being held by nuts under the planks.

All material is creosoted, with a specified retention of 18 lb. per cubic foot for piles and 16 lb. for timbers. When the piles are cut off to grade for the caps, the top is well saturated with hot creosote oil and then given a heavy coating of a mixture of creosote and pitch. All field bolt holes are swabbed with this mixture, but some of the material was shaped and framed before treatment. Piles are from 78 to 90 ft. long, with a penetration of 65 to 70 ft.

Steel Spans—Through girder spans, 67 ft. 6 in. between bearings, consist of a pair of 70-ft. girders, 10 ft. deep and 30½ ft. apart, with 44½-in. plate-girder floor beams connected by gusset plates to the girder webs. Between the floor beams are nine lines of 18-in. I-beam stringers carrying the concrete deck slab, which is 7 in. deep, with an additional inch to provide for drainage planes. The curbs or guard-rails rise 8½ in. above the slab. This slab, which rests upon the top flanges of the I-beams, is poured in two longitudinal sections, with two layers of tarred felt roofing in the construction joint.

Between the floor beams, which rise above the slab, the surface of the concrete is in drainage planes leading to 4-in. drains of cast-iron pipe, the pipes extending below the level of the lowest steel. Ballast is arranged as on the pile trestle. The gap between the slab and the adjacent plank deck is covered by a ⅜ in. wrought-iron plate 18 in. wide and bolted to the concrete.

For the I-beam spans, 34 ft. 3 in. between bearings, there are nineteen lines of 27-in. I-beams, 35 ft. long, spaced about 16½ in. c. to c. and connected by diaphragms 7½ ft. apart. The concrete deck slab and ballast arrangement are similar to those on the girder spans. In both structures the top flanges of the I-beams are covered with a bituminous prime coat and mastic enamel before the concrete is placed. The concrete is kept wet for seven days, and the bottom forms are left in place for that time. All steel spans are designed for Coopers E-60 loading and are under the 1931 specifications of the American Railway Engineering Association (as modified for the Illinois Central Railroad).

Concrete Fire Walls and Piers—Fire walls or firestop piers built to sectionalize the timber trestle by replacing occasional pile bents, have a 36-in. footing course 34x8 ft. on 29 piles. The shaft tapers from 49 in. thick at the base to 24 in. below the corbeling for the bridge seats. While the body of the shaft is 26 ft. wide, it is extended at each end by a 9-in. rib 3 ft. wide, making a total width of 32 ft. The rib extends above and across the top of the pier to base of rail, forming a firestop between the decks of the two adjacent trestle spans. For the girder spans the piers have 5-ft. footings 45 ft. 9 in. x 12 ft. 6 in., on 73 untreated piles 60 to 70 ft. long, with a load of about 12½ tons per pile. Deck stringers of the adjacent trestle spans rest on the back walls of the bridge seats and are secured by anchorbolts. Piers for the I-beam spans are somewhat smaller.

Construction—The large amount of piledriving was done by a double-track piledriver (Fig. 2) having a tower 52

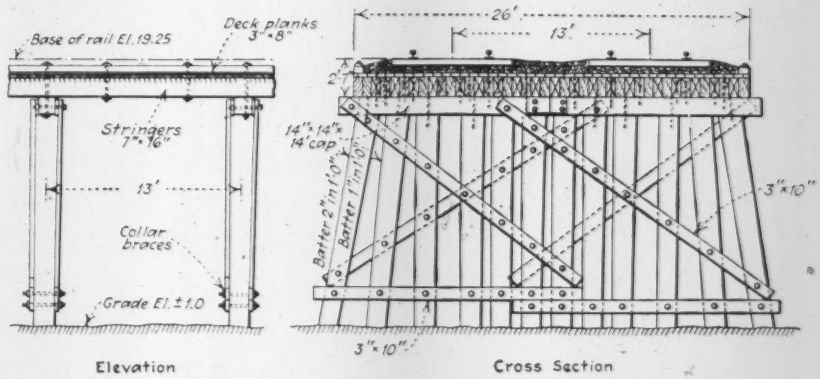


FIG. 3—STANDARD double-track, ballasted-deck pile trestle being built by Illinois Central across Bonnet Carré spillway.

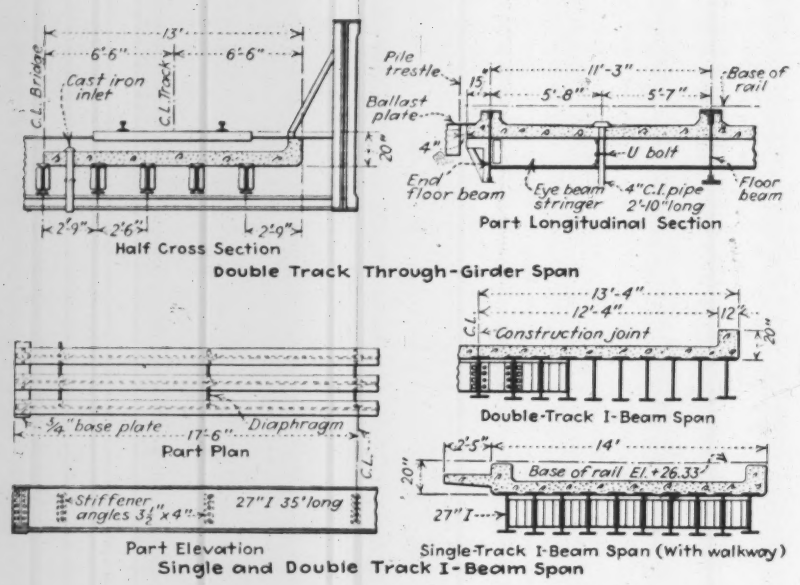


FIG. 4—DETAILS OF STEEL SPANS which are built into the I.C.R.R. timber trestles at intervals to serve as firestops.

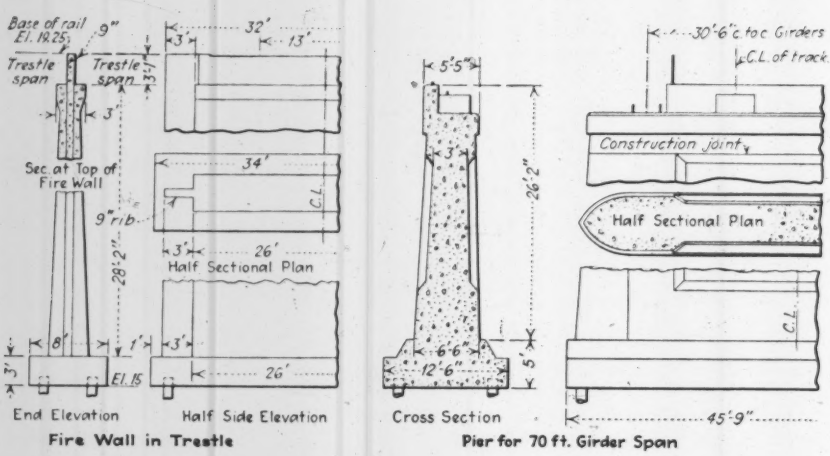


FIG. 5—PIERS AND WALLS of reinforced concrete act as firestops with trestles of the I.C.R.R.

ft. high, on which the leads (with steam pile-hammer) could be traversed for the width of a bent and also adjusted for driving the batter piles. The greatest penetration was 70 ft. below ground, plus about 18 ft. to grade. Concrete was mixed and placed by a set-up at each unit. Extensive use of machine and power appliances was a special feature of the construction work.

Yazoo & Mississippi Valley trestle

This single-track line, a subsidiary of the Illinois Central System, is carried across the spillway by a trestle 8,000 ft. long, flanked at each end by about 545 ft. of fill, the distance between the levees being 9,099 ft. The grade line at El. 26.33 is about 19 ft. above ground and 7 ft. above estimated flood level. A timber trestle forms the main part of the structure, but as a precaution against fire it is interrupted at intervals by concrete firestop walls or piers and by I-beam spans on concrete piers. Thus the 593 spans or panels of trestle are divided into seventeen groups of 30 to 43 spans, separated by fire walls and I-beam spans alternately. There are no girder spans as in the Illinois Central structure.

Trestle construction consists of spans 13 ft. c. to c. on six-pile bents in which the two outer piles on each side have a batter of 2 in 12 and 1 in 12, respectively. Each bent has swaybraces and collar braces on each side. On the 14x14-in. caps, 16 ft. long, are twelve lines of 7x16-in. stringers, 7 in. apart, carrying a tight deck of 3x8-in. transverse planks, 16 ft. long. As the structure is single track, these planks are extended 2 ft. beyond the outer stringer on the east side, so as to form a continuous walk for trainmen. This walk is provided with a steel cable hand-railing on wood posts. At intervals there are caps 24 ft. long to support refuge for section cars, each consisting of a platform 8x14 ft., with hand-rail.

Ballast is 6 in. deep under the ties and 3 in. on the walk and platforms. Over each outer stringer is bolted a guard timber 6x8 in., which retains the ballast. Where water barrels are placed, planks bolted against both sides of the cap extend 4 ft. beyond the stringer and carry cleats to support the barrel, which is secured in place by stay rods, as already described.

Steel I-Beam Spans—Each single-track span, 34 ft. 3 in. between bearings, consists of ten 27-in. I-beams 35 ft. long, with diaphragm plates riveted to stiffener angles on the webs at intervals of 7½ ft. This construction is shown in Fig. 4. At the ends the bottom flanges are riveted to flat transverse plates that rest on the bridge seats. Each span was shipped in two sections, ready for erection. The deck is a poured concrete slab, 14 ft. wide over the curbs that retain the ballast. It is 8 in. thick in the middle and 7 in. at the curbs, with the top sloped in planes to 4-in. drain pipes. On the east side the slab has a cantilever shelf 2 ft. 5 in. wide, forming the walkway and carrying timber posts with wire-cable hand-railing. At the end of each span the gap between the slab and the adjacent trestle deck is covered by a wrought-iron ballast plate bolted to the concrete.

Concrete piers for the spans and fire walls are founded on untreated piles 50 to 60 ft. long. The average load per pile is about 12½ tons. These walls or firestop piers are similar to but smaller than those of the double-track structure already described. On 36-in. footings, 21½x8 ft., the body of the pier is 14 ft. long but extended on each side by a middle flange or rib 9 in. thick and 3 ft. wide, making the total width 20 ft. This rib extends above and along the top of the wall, separating the bridge seats and rising to the level of base of rail, thus forming a firestop between the ties. The wall is 3 ft. 8 in. thick at the base, 2 ft. below the corbeled bridge seats and 3 ft. over the bridge seats. Piers for the spans have 48-in. footings, with the shaft 17x5 ft. at base and 15x3 ft. at top. All piers and walls are heavily reinforced.

Engineers and Contractors—The design and construction of these two unusual structures were under the direction of C. C. Westfall, engineer of bridges, Illinois Central System. Pile-driving and trestle construction, as well as steel erection on the double-track line, were done by company forces. Concrete piers and fire walls on this line were built by the Walsh Construction Co., Indianapolis, Ind., while concrete work and steel erection on the single-track line were handled by the

R. J. Reid Contracting Co., Birmingham, Ala. All steelwork was fabricated by the Virginia Bridge & Iron Co. For the two trestles there are about 1,130,000 lin.-ft. of treated piling, 137,000 lin.-ft. of untreated foundation piling, and 8,400 cu.yd. of concrete. Work was begun in March, 1934, and is to be finished by April, 1935.

Steel spans on pile bents

A trestle span composed of a combination of steel spans on timber bents (Fig. 6) is the unusual type of structure adopted for the crossing of the Louisiana & Arkansas Railroad. At this crossing the width of the spillway channel is about 10,000 ft. between the levees, and the total length of the structure is 9,087 ft., no earthfills being within the channel. The track is now raised from the old shallow fill to a new structure 35 ft. east of the old location and about 20 ft. above the ground, the change being made by approach grades of 0.50 per cent. With the flood level estimated at El. 17.50 above sea level, the base of rail is nearly 7 ft. higher, at El. 24.40, while the lowest steel is at El. 21.50, giving a minimum clearance of 4 ft.

In this trestle the standard length of the steel spans is 20 ft. c. to c. of bents, but for greater stability these spans are in groups of 44, or 880 ft., separated by double or tower bents 5 ft. 10 in. c. to c., with the center lines 20 ft. from those of the adjacent standard bents. There are no fire walls or concrete piers. Firestops in the deck, which is not ballasted, consist of groups of steel H-beam ties substituted for timber ties.

Standard pile-bent construction consists of seven piles with 4x10-in. swaybraces and collar braces on each side. Outside piles and those next to them have a batter of 2½ in 12 and 1 in 12 respectively. The caps are 14x14 in., 14 ft. long, drift-bolted to the piles. For the towers, each bent has five piles, with longitudinal struts and X-bracing on the four batter piles, in addition to the transverse swaybraces and collars. The caps are set 14 in. lower than on the intermediate bents and carry a group of longitudinal timbers 14x14 in. and 7 ft. long.

On the upstream side each tower is sheathed with horizontal planks 7 ft. long, to prevent the lodging of driftwood and to withstand the force of flood waves. Each tower has at one side a refuge platform for motor section cars. This is carried by ties 20 ft. long, supported by extending the swaybraces to act as kneebraces. A plank floor and wooden hand-railing complete the refuge.

Each 20-ft. steel span consists of four lines of 27-in. I-beams, spaced 30 in. c. to c., and connected by diaphragms of steel plates riveted to stiffener angles on the webs of the beams. At each end the beams are connected by a transverse 12-in. sole plate riveted to the bottom flanges. This plate in turn rests on a 14-in. bed plate on the cap, or laid across the longitudinal timbers of the tower deck.

Upon the steel spans is a typical open deck composed of 8x8-in. ties, 10 ft. long, spaced 12 in. c. to c. Guard timbers 6x8 in., laid flat and dapped 2 in., are fastened by hook bolts to the I-beams at each fourth tie and by lag screws in the intermediate ties. The track is laid with 85-lb. rails on tieplates, and inside these are 70-lb. guard-rails spaced 3 ft. apart.

Firestops are provided in the middle of the decks of the two spans adjacent to each tower (Fig. 6). The stop consists of five 8-in. H-beams 10 ft. long and 12 in. c. to c., in place of the ordinary wood ties. These are fastened to the 27-in. I-beams of the span by bolts through the flanges. The track rails are seated on ½-in. flat plates, and both the track rails and the guard-rails are secured to the ties by bolted clips. The outside guard-timbers are continuous across the firestops, and are secured to the ties by hook bolts.

The structure is designed for Cooper's E-60 loading and allows a load of 30 tons per pile. Piles 70 to 75 ft. long were required and aggregated about 257,000 lin.ft. They were driven by a track piledriver. All piles and timbers were creosoted under specifications requiring an average retention of 16 lb. per cu.ft. Much of the framing was done before treatment.

This timber and steel trestle was designed by E. F. Salisbury, chief engineer, Louisiana & Arkansas Railway, and Harrington & Cortelyou, consulting engineers, Kansas City, Mo. Contracts were let to List & Weatherly, Kansas City, Mo., for the trestle, and to the Gifford Hill Construction Co., Dallas, Tex., for the approach grading. By October, 1934, about 50 per cent of the work was done, and the structure is to be completed by March, 1935.

Concrete highway trestle

For the state highway crossing of the Bonnet Carré spillway channel, a standard design of reinforced-concrete pile trestle with a 40-ft. roadway was adopted by the engineers of the state highway commission. It is located on a new and direct concrete road between New Orleans and Baton Rouge, taking the place of the old Jefferson Highway, which follows the course of the river and will be abandoned. Although the distance between the levees is about 10,300 ft., the length of structure is only 6,000 ft., having at each end about 2,150 ft. of earthfill, inside the levees.

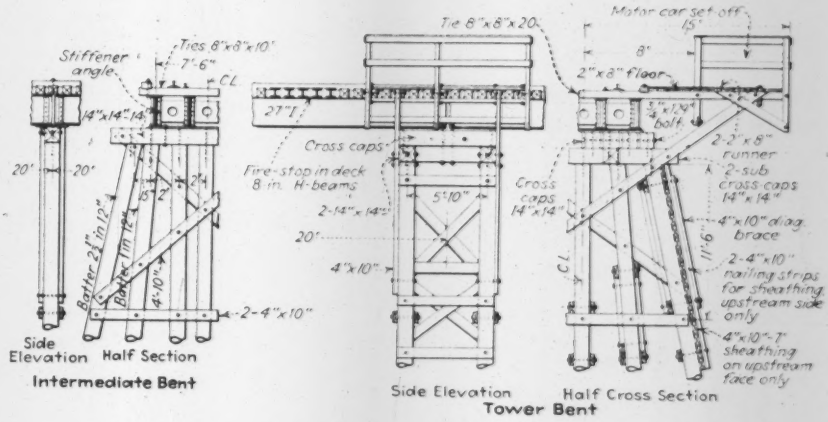


FIG. 6—STEEL I-BEAM SPANS on timber-pile bents and towers comprise the trestle of the Louisiana & Arkansas R.R.

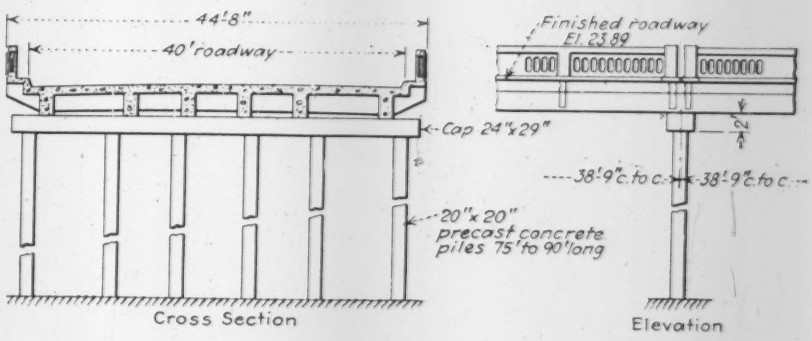


FIG. 7—CONCRETE PILE TRESTLE carries Louisiana state highway across Bonnet Carré spillway.

FIG. 8—GANTRY CRANE loading 80-ft. concrete pile onto cradle on flat cars for transportation to site of highway trestle.

The outer 200 ft. of each fill is protected from erosion by a revetment of concrete blocks.

As to these approach embankments within the spillway channel, the U. S. Engineer Office recommended and approved a length of 6,000 ft. for the trestle because the velocity of flow at this location was not expected to be sufficient to erode the bottom of the spillway between the guide levels. The trestle spans are longer than those of the needle-dam at the head of the spillway and thus provide less obstruction to the flow. Furthermore, the area adjacent to the highway trestle is heavily timbered, and it was considered that no exceptional risk was involved in reducing the length of trestle to 6,000 ft. It appears that the railways also were at liberty to make similar reductions in their structures but preferred to make them of greater length.

The concrete trestle (Fig. 7) is of simple design, with six-pile bents spaced 38 ft. 9 in. c. to c. and capped to carry five lines of beams built integral with the roadway slab. Short cantilever extensions of the slab carry the curbs and concrete railings. The precast piles are 20x20 in., 75 to 90 ft. long, made with high-early-strength cement. Upon their heads were poured the caps 24x39 in. At this crossing the flood level is estimated at El. 18, and the structure was designed with its roadway at El. 23.89 and lowest point of spans at El. 20.58.

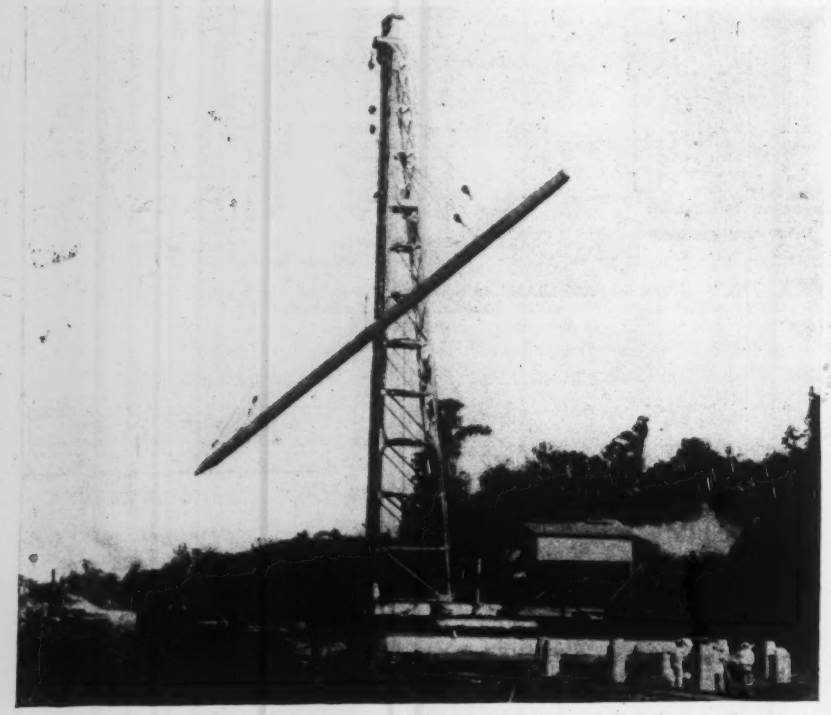


FIG. 9—PILEDRIVER with special tackle unloads 90-ft. concrete pile and swings it to vertical position in the leads on highway trestle construction.

Before the design was selected, 50 concrete test piles 20 in. square and 75 ft. long were driven to various depths and loaded by 5-ton concrete blocks. These blocks were square, with a square hole in the middle, the lower ones being threaded over the pile and supported on a steel stirrup hung on the pile head. Failure, by overcoming the skin friction in the soil (which was too soft to give any point bearing) occurred with loads ranging from 70 to 160 tons.

Preliminary alternative designs included six and seven piles per bent and spans of 28, 34 and 38 ft., giving six combinations, with pile loadings ranging from 29 to 43 tons. Bids were taken on these several designs. After the test piles had been driven and loaded, the records were used in selecting the most economical length of pile, the number of piles per bent and the length of span, taking into consideration also the prices bid on the different items. The most economical design was that with six-pile bents and spans of 38 ft. 9 in., for which the load per pile was 43 tons, including maximum live load and dead load. The contract included unit prices for piles 75 ft. long and under, and for piles from 76 to 90 ft. long.

Pile handling

Steel forms are used for the piles, and wood forms for the caps and spans. Forms for the spans are supported on I-beams hung on stirrups attached to the concrete caps. At the pile-casting yard the piles are handled by a gantry crane with a strongback beam holding the pile by clamps at three points. For transportation an old engine-house turntable mounted on a flat car serves as a cradle in which the pile is laid, as shown in Fig. 8. For driving, the pile is handled by lines of tackle on the pile-driver, this being so arranged that after being lifted from the train in a horizontal position the pile is turned gradually to a vertical position by slacking off and hauling in the lines. Fig. 9 shows a 90-ft. pile being handled in this way. It was not necessary to cut off any piles to grade for the caps, but several piles were driven below grade. For these the concrete was broken away at the head to expose the reinforcing steel, and an extension was built up to the required elevation for the cap. One of the 80-ft. piles penetrated to a depth of 60 ft. under the weight of the pile-hammer.

For the long end fills, involving about 700,000 cu.yd. of clay and earth, the specifications provided a borrowpit site across the channel, just below the location of the bridge. In construction, however, the contractors preferred to secure two borrowpits outside the guide levees, hauling the material in 4-yd. dump cars operated in trains on industrial railroad tracks of 3-ft. gage. A

dragline excavator loaded the cars. The dump track was on the center line of the roadway and was raised by tamping material under the ties as filling progressed. As the material was dumped on other side of the track, it was spread by another dragline machine on the fill, where it was rolled with a crawler tractor having a grader blade. Both fills were carried on simultaneously.

This highway and bridge project is being financed jointly by the Louisiana highway commission and U. S. Bureau of Public Roads. During the construction of the bridge the engineers have studied and recorded important features relative to the driving and loading of piles in alluvial soil, the subsidence and shrinkage of fills deposited on such soil, and the casting, curing and driving of concrete piles made with high-early-strength cement. For the concrete structure the contract was let to the Keliher Construction Co., Dallas, Texas, at approximately $800,000, while that for the approach embankments was let to the Gifford-Hill Co., also of Dallas, at about $350,000. At the end of September, 1934, both contracts were 50 per cent completed. Design and construction of the concrete trestle were directly under N. E. Lant, bridge engineer, Louisiana highway commission.

Railway Track Refinements Required by Higher Speeds

Studies made in connection with introduction of light-weight, high-speed trains into regular service on the Burlington Lines indicate that minor improvements in line and surface will meet the new requirements amply—Speed reduced in specified zones

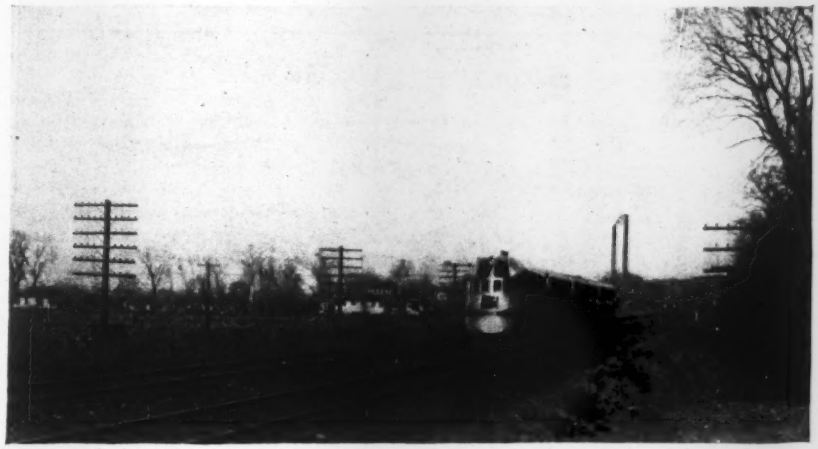


FIG. 1—THE BURLINGTON ZEPHYR on its first regular run, near St. Joseph, Mo.

THE ADVENT of high-speed passenger trains of the diesel-motor type, such as the "Zephyr" of the Burlington Lines, has introduced new problems in track maintenance. Present main-line track is adequate structurally to sustain the weight of the present equipment and is maintained in line and surface for safe and comfortable riding at speeds that seldom exceed 60 miles an hour. With the prospect of speeds increased to 100 miles per hour, and occasionally higher, it became evident to railroad engineers that new refinements in track maintenance, and possibly some realignment where curvature is sharp, would be needed.

A typical example of the way in which this subject has been approached is given by the work undertaken by engineers of the Burlington Lines preparatory to putting the "Zephyr" into service, between Chicago and the Twin Cities.

As the time for making test runs with the new equipment approached, the section of track over which it was proposed to put the new train into regular service (Chicago to Minneapolis and St. Paul) a thorough study of existing track conditions was made by maintenance and operating officials. When the train was ready for service, test runs were made in order that the engineers might determine the comfortable speeds at which the train could be operated over existing track, and as a result of these tests the entire line was zoned for permissible speeds. These tests indicated the need for one major change in alignment and some minor track improvements.

Characteristics of the line

The first 38-mile section, Chicago to Aurora, is a multiple-track line with light grades and little curvature. From Aurora to Savanna, 107 miles, the line is single-track over the broken terrain characteristic of northern Illinois. The grades are undulating with a maximum of 1 per cent, and the curves generally are 2, 3 and 4 degrees, or sufficient to preclude a sustained high speed but permitting the maximum to be attained on some stretches. From Savanna to St. Paul, 285 miles, there is a double-track line with light grades and curvature, making it ideal for high-speed service.

One line change was made on the Aurora division west of Honey Creek, Ill., which eliminated 73 deg. 10 min. of curvature, cut the maximum grade from 0.84 to 0.5 per cent, and reduced the maximum degree of curvature from 4 deg. to 1 deg. 30 min. The line was shortened about 270 ft.

Train speed

As a result of the tests, the speeds shown in the accompanying table were established, and a graph of speed zones (Fig. 2) was prepared.

AVERAGE AND LIMITING SPEEDS, CHICAGO TO ST. PAUL

	No. Miles	Steam Trains Speed Limit	Steam Trains Aver. Speed	Streamline Trains Speed Limit	Streamline Trains Aver. Speed
Chicago-Aurora	37.8	65	45.5	90	68.5
Aurora-Savanna	107.8	60	45.9	90	72.7
Savanna-St. Paul	284.7	65	47.1	90	70.6

Curves

It was found that speeds had to be reduced on curves of 2 deg. or more because the superelevation required to meet the maximum speed was so great as to be detrimental to the operation of steam trains at slower speeds. With the permissible superelevation and through the use of spirals, the maximum speed may be attained on curves up to 2 deg.

The procedure in establishing the superelevation was to measure the amount of superelevation on all curves, check these elevations against the calculated elevation for "comfortable speeds" at established speed zones, and then determine the amount of additional elevation necessary. The figures tabulated on p. 18 are a summary of the changes in superelevation.

In order that operation of standard passenger and freight trains might not be unduly affected, a maximum of 5-in. superelevation was adopted, and when

CHANGES IN SUPERELEVATION ON CURVES

Mile Post	Degree Curve	Zone Speed	Superelevation in Inches Present	Superelevation in Inches For "Zephyr"	Calculated Comfortable Speed
53.25	1°0′	90	2	2½	95
83.80	4°1′	45	3½	3½	51
91.00	2°6′	70	3½	4	75
91.20	2°21′30	70	4	5	72
134.40	2°30′	60	4½	4	72
144.60	3°14′	45	½	1½	50
366.00	3°0′	60	3½	4	61

conditions required anything in excess of 5 in., the situation was met by restriction of speeds.

All curves up to and including 2 deg. were elevated for the zone speed limit. If in any speed zone there were any curves (over 2 deg.) that necessitated speed restriction, such curves were marked with a special track sign indicating the restricted speed. These signs are set 3,000 ft. in advance of point of curve, for information of motorman. Likewise, all speed zones are similarly marked for information of motorman.

Studies confirmed

The test runs confirmed the preliminary mathematical determinations of superelevation and spiraling required. Theoretically, the application of the spiral in standard use on the Burlington called for a spiral so long as to require extensive throw in the track. Consequently, a modified form of spiraling was developed and applied to such curves as required adjustment for the proposed higher speed, advantage being taken of the much lower center of gravity of the new type of train.

Maintenance of the maximum speed of 90 miles per hour through as long a period as possible is desirable in the interests of time saving, for while trains of this type accelerate quickly from a standstill to about 60 miles per hour, acceleration to higher speeds is slower and, therefore, speed changes are not made as quickly as at lower rates.

In addition to the relocation undertaken at Honey Creek, as previously noted, a 12–3-deg. compound curve in one of the station grounds with a central angle of 29 deg. 28 min. was replaced with one 4-deg. and one 3-deg. 55-min. curve separated by a short tangent. This greatly improved operating conditions both for the high-speed train as well as the regular speed trains.

In both these instances, the line revisions were found economically justified without reference to the high-speed train.

FIG. 2—A GRAPH of the speed zones between Chicago and Minneapolis has been prepared to indicate the zones where speeds must be restricted.

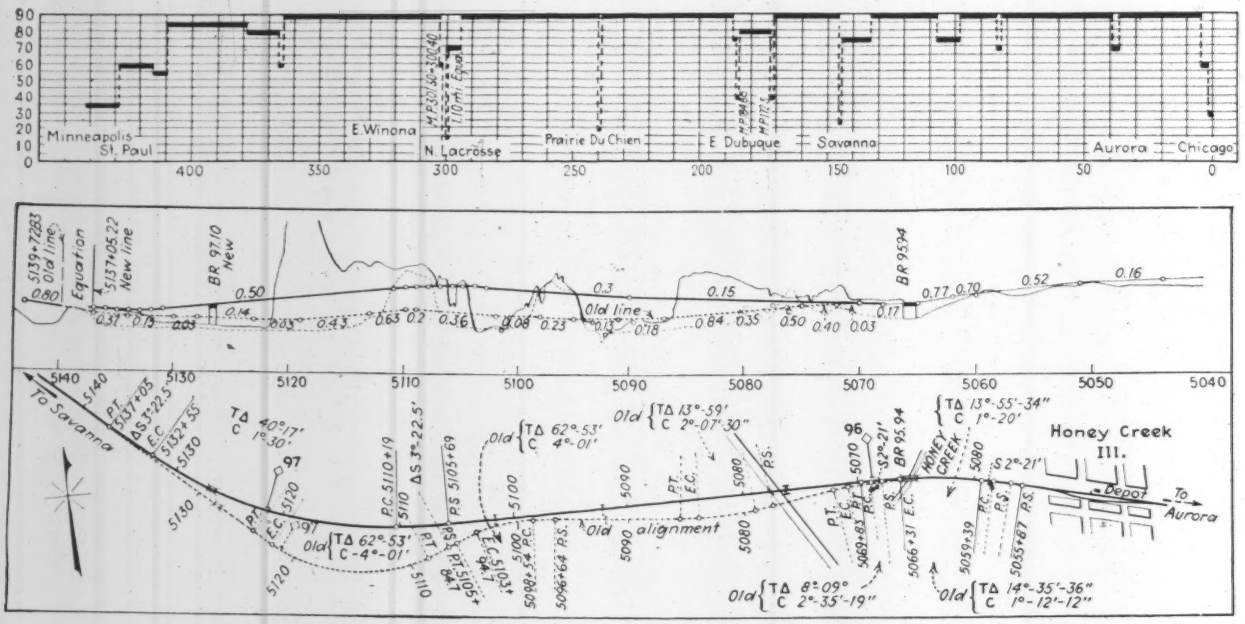


FIG. 3—LINE CHANGES west of Honey Creek, Ill., improve the grade and cut the maximum curve from one of 4 deg. to one of 1 deg. 30 min.

Track maintenance

In general, it was found that after the curve adjustments had been made, the new high-speed train placed little added demand on the track maintenance forces. With the present standard track construction of heavy rail, full-size treated ties, large tieplates and a full ballast section, the new train, on account of its light weight, is expected to have little effect upon the track even when operated at higher speeds. However, inequalities of surface that are not noticeable at ordinary speeds are emphasized at higher speeds, and as a result the maintenance forces have to give more careful attention to the maintenance of a uniform surface.

Signal changes

In general, it was found that the block signals are spaced sufficiently far apart to meet the braking requirements of the high-speed train. Because of the particularly efficient braking system, this new type of train running at from 80 to 90 miles per hour will not require a braking distance longer than does a steam train running at from 60 to 70 miles per hour. In a few special cases adjustments have been made in the signal system to provide a longer braking system.

Highway grade-crossings

At some highway crossings it has been found necessary to lengthen the track circuits because existing regulatory laws require the signals to be operated 20 sec. in advance of the train reaching the crossing. Circuits generally are installed on the basis of 60-mile-per-hour speed, or 88 ft. per second. Signals begin to operate when the train is about 1,800 ft. from the crossing. For speeds of 90 miles per hour, circuits to operate on 20-sec. requirements would have to be lengthened so that the signal will begin to operate when the train is 2,640 ft. from the crossing.

This work was carried out under the general direction of Ralph Budd, president, and A. W. Newton, chief engineer, Burlington Lines.

Broad Development Plan Proposed By Mississippi Valley Committee

Established by the PWA to plan for the use and control of water within the Mississippi Drainage Basin, the committee outlines a development program for power, domestic water supply and disposal, irrigation, flood control, navigation, land use and recreation

COORDINATION of the many uses to which water may be put to obtain the greatest benefit to the largest number of people is proposed for the waters of the Mississippi River Basin in the report of the Mississippi Valley Committee of the Public Works Administration made to the Federal Administrator of Public Works, just published. The committee, according to the postscript of its report, was "to make a plan for the use and control of water within the Mississippi drainage basin, a vast area comprising all or part of 31 states." It was appointed in November, 1933, to coordinate and correlate the many projects within the basin and thus to provide the Public Works Administration with criteria for either approving or rejecting projects put up to it for financing. The committee consisted of Harlan H. Barrows, Herbert S. Crocker, Lt.-Col. Glen E. Edgerton, Henry S. Graves, Major-General Edward M. Markham, Charles H. Paul, Harlow S. Person, Sherman M. Woodward, and Morris L. Cooke, chairman. The committee's report is dated Oct. 1, though it was not made public until Dec. 26.

Since the establishment of the National Resources Board, the Mississippi Valley Committee has been re-constituted as the Water Planning Committee of that board, and its report on the use of national water resources is expected to be made public in the near future.

Many subjects covered

Planning for the most beneficial use of the waters of the Mississippi basin required, the committee says, exploring the many fields of human activity to which water use is related. Its approach to the subject is summed up in its introductory statement: "Planning for the use and control of water is planning for most of the basic functions of the life of the nation. We cannot plan for water unless we also consider the relevant problem of land. We cannot plan for water and land use unless we plan for the whole people. It is of little use to control rivers unless we also master the conditions which make for the security and freedom of human life." This broad approach to the subject resulted in the committee going into a consideration of such subjects as developing the market for hydro-electric power, into forestry, wild life conservation, and recreational use of land and water. Its specific recommendations are summed up in the following:

1. Unification through federal control of transmission of the entire national electricity supply to effect both economy and stability, and to make it possible to tie even remote hydro-electric developments into a common system.

2. The utilization for the generation of electricity of all dams built primarily as aids to navigation or for flood control.

3. A widespread extension of rural electrification, estimated as including one to three million farms.

4. Completion of navigation facilities on the main stem of the Mississippi and connections with the Great Lakes.

5. Extension of navigation on tributaries only where intensive studies indicate economic justification.

6. The establishment of a commission to regulate inland water transportation.

7. The unification of all forms of transportation as parts of a coordinated system.

8. A program of balance between protection of certain areas and relinquishment of others, unoccupied by settlement, to hay and forest crops.

9. Employment of all methods of controlling floods—channel improvement, levees and floodways, and retarding reservoirs.

10. A program of flood control on major tributaries such as the Ohio, Missouri and Southwest rivers; and at strategic transportation centers such as the Kansas Citys.

11. Protection of top soils on public lands by protection of existing vegetative cover through more effective fire prevention and regulation of grazing, and by planting vegetative cover on exposed areas.

12. Vigorous cooperation with states in promotion of rural and land zoning, allocation of land use, forestation, and restoration of grass crops; and in development of farm practices such as strip cropping, terracing, rotation and mulching.

13. Caution with respect to further extension of irrigation in view of the present agricultural situation as a whole and on irrigated lands.

14. Improvement of existing projects and protection of investments in irrigation works and farms from deterioration.

15. Promotion of individual farm supplementary irrigation in humid regions as promising larger and more stable crop yields.

A twenty-year development plan

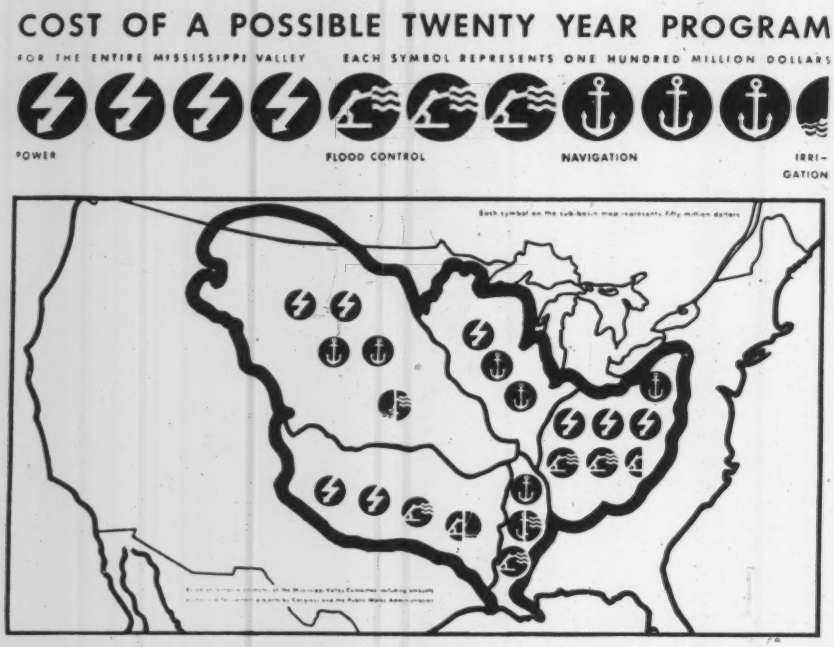
From the point of view of engineering and the practical arts, the report states, the three points of attack upon the problem of the development of the river basin are, first, a better adjustment to water on the land at the time of precipitation by farm and forestry practices which retard rapid runoff and erosion and promote infiltration; second, control by works of various kinds which eliminate or reduce the extensive variations of streamflow, with amelioration of their harmful effects and promotion of various uses; and third, treatment of sewage, industrial, mine and other wastes so that they will not have a polluting effect on waters necessary for domestic, industrial and recreational uses.

The committee believes that by a long-run, flexible program of public works relating to the use and control of water, a considerable degree of industrial stabilization could be achieved, as the demand for labor and materials would serve as a continuous stimulant to the heavy industries and as a means of balancing employment directly and indirectly in both good and bad times. During the next twenty years, it states, the federal government could profitably spend one billion dollars on river works in the Mississippi Valley, 50 per cent of which would be self-liquidating. Such a program would require continuous preparation for the next step; economic and engineering studies to determine the order of projects on the basis of local needs and general benefits; and detailed surveys and the preparation of basic plans in order to have them in hand for prompt action in accordance with public policy of action at any particular time.

Flood control

On the subject of flood control the report states that any coordinating system of control will demand the cooperation of neighboring states as well as the cooperation of the states with the federal government, and to make this easily possible there is need for uniform state flood-control laws and federal legislation to expedite interstate compacts, also a permanent policy of federal participation based on accurate estimates of benefits to be derived. It is suggested that the federal government might pay 30 per cent of the cost of labor and material for projects of chief benefit only to local communities and a larger proportion as measurable general benefits increase.

The disadvantages as well as advantages that attach to any river develop-



THE COST of a 20-year development program in the Mississippi Valley is here shown in diagrammatic form. The large symbols represent $100,000,000, and the smaller symbols on the map represent $50,000,000. This diagram is typical of the diagrams used throughout the report.

ment are cited as evidence of the need for careful restudy of our whole system of inland transportation in order to determine the proper place of inland waterways in a coordinated national transportation system. It may be desirable, the report states, to introduce a new element by imposing charges where they are justified by special services and special facilities and where the traffic can bear them. The movement toward ultimate unification of transportation services might be hastened by setting up a commission to regulate water rates and to cooperate with the Interstate Commerce Commission in the fixing of joint rates for rail and water transportation.

Power

A considerable part of the committee's findings is given over to the subject of power development and distribution. The report recommends that the federal government regulate the transmission of electric current, regardless of the number of generating plants or transmission lines that it may ultimately own. As half of the expenditure of one billion dollars that the committee states the federal government could spend in the next twenty years would be for self-liquidating power projects it holds that the government could use the power to "experiment as well as regulate."

"An allotment of $100,000,000 to build independent, self-liquidating rural electric projects would be a safe and socially justifiable experiment. Such an enterprise would not compete with private capital, since it would serve territory not now served or likely to be served in any other way. There is every reason to expect that the low rate which would be possible would result in a great expansion in the rural uses of electricity and consequent increase in rural living standards."

Water supply

On the subject of water supply and sanitation, the report emphasizes the need for uniform state legislation and for cooperation between state and federal agencies in the collection of data relating to water supplies and sanitation, and in the matter of the establishment of water supply and sewage-disposal districts.

Direct losses due to soil erosion are stated to amount to $400,000,000 annually, and the cost of protecting land against erosion is estimated at about $20,000,000 a year.

Irrigation

Neither the agricultural situation as a whole nor the situation on irrigated land justifies federal action to extend irrigation in the West, says the committee. Where necessary, steps should be taken to protect the investments in irrigation work and irrigation farms from deterioration. Irrigation should be studied in connection with the recommended national program of land use. Particularly should there be more accurate estimates of costs and profits.

Important sections of the report, in so far as civil engineers are concerned, are those devoted to precipitation and runoff and to groundwater and the watertable. The information given is a summary of a large amount of information collected by the technical staff of the committee. It includes significant data on the lowering of the watertable in the Great Plains states.

Specific recommendations

About half the report is devoted to separate discussions of the water and regional problems of the several sub-basins into which the committee divides the main Mississippi River Basin: the Upper Mississippi, Ohio, Missouri, Southwest, and Lower Mississippi.

Upper Mississippi—Except for completion of the present navigation project for a 9-ft. channel to the Twin Cities, the committee makes no recommendation for immediate federal undertakings. Among the projects presented to it for consideration, but which it believes cannot at present qualify as presenting any large amount of federal interest, are the Red Lake dam, the Lake Traverse-Boise de Sioux dam, the Mouse River dam, the Lac Qui Parle dam, and the Whestone River-Big Stone Lake Reservoir diversion.

Ohio Basin—In the Ohio basin the report calls attention to the fact that the Public Works Administration already is participating in two flood-control projects, the Tygart Reservoir and the Muskingum Valley project. A list of thirteen reservoirs on the Monongahela, Allegheny, Kanawha, Licking and Beaver rivers, taken from the "308 Report" of the Corps of Engineers, is included as "reservoirs which appear to deserve recommendation for inclusion in a coordinated flood-control plan for the Ohio basin." The federal government is bearing all the cost of the Tygart Reservoir and is sharing in the cost of the work in the Muskingum Valley. Partial participation in the thirteen other reservoirs is proposed, the federal share of the total undertaking being a little over half of the estimated cost of $117,000,000.

The proposed Beaver-Mahoning canalization, to provide a 12-ft. channel from the Ohio River to Struthers, Ohio, a distance of 35 miles at an estimated cost of $47,000,000, is considered, but the committee states that "unless or until an arrangement can be made whereby beneficiaries under a liberal repayment schedule will return to the government its cost of construction, operation and maintenance, it is suggested that a new project of this class might better be held in abeyance pending reconsideration of a new navigation policy."

No water power projects in addition to those being developed by the Tennessee Valley Authority are recommended.

Missouri Basin—Flood control in the lower part of the Missouri Basin is recommended, especially in the Kansas Citys, but no specific recom-

mendations are made. The Kiro dam, one of the proposed flood-control projects, is rejected as impracticable because of the excessive cost. However, an investigation of the subject is recommended in order to determine the practicability of controlling floods on the Kansas (or Kaw) River through the agency of a conservancy district. Further, it is recommended that favorable consideration be given to the construction of flood-control reservoirs at Harlem, Saco, Glasgow, and Forsythe, Mont.; Belle Fourche, S. D.; Ottawa and Fort Scott, Kan.; and Marmarth, N. D., provided arrangements can be made for local participation in the cost of their construction.

It is recommended that no further navigation projects in the Missouri basin be undertaken until the present project for improvement of the Missouri below Sioux City is completed, and its benefits, if any, have been determined. Abandonment of the Osage River navigation project is recommended.

Detailed study is recommended of the Gillette coal-power project in which a steam plant at the government-owned lignite deposit in Campbell County, Wyo., would serve the farms, towns and industries in the Black Hills uplift with low-cost electricity. The Black Hills Power District has been formed and has applied to the PWA for a loan of $9,225,000 to finance the work. The report says: "Federal participation in the Gillette project, if warranted by the contemplated survey, should not be confined to making the requisite loan under the regulations of the Public Works Administration. Here is an exceptional, if not unique, opportunity to establish a useful precedent for the formation and execution of an integrated regional plan through the cooperative efforts of local and federal interests. Because of the nature of the consuming area, this proposal seems to afford a splendid opportunity for social betterment through the medium, in part, of an abundant supply of low-priced power."

An active program of erosion control along the headwaters of the Yellowstone and the Big Horn rivers is recommended.

Southwest Basin—The many projects in the river basins of the southwestern part of the valley, Red, Arkansas, White, and Ouachita, have been grouped into three classifications by the committee. Class A includes projects which appear to be economically justified by the benefits to be derived from their construction or which, though perhaps lacking in some degree of economic justification, are exigent in character. Into Class A fall the following large projects: Cado reservoir on the Arkansas River, Pensacola reservoir on the Grand River, Conchas reservoir on the South Canadian, and Fort Reno reservoir on the North Canadian River, Table Rock dam on the White River.

Lower Mississippi Region—No specific recommendations are made as to projects to be undertaken in the lower Mississippi basin, but the committee discusses in detail the relation of the federal government to future efforts to protect land from flooding and outlines what it believes should be the federal government's policy as to participation in the cost of such work.

Letters to the Editor

Continuous Beams

Sir—The continuous-beam analysis (*ENR*, Dec. 20, 1934, p. 782) is an ingenious merger between the fixed points proposed by Messrs. Schulze and Rose and the Cross method. The introduction of the reduced moment coefficients is novel.

The practical value of these novel, ingenious and correct reasonings is, however, small for the following reasons:

First, the Cross method seems to give quicker results because it is easier to redistribute unbalanced moments than to determine the reduced moment coefficients.

Second, if the fixed points are known, there is no need to calculate the fixed-end moments because it is possible to obtain the final moments at once. It has been found that if only one span is loaded, one may imagine that this loaded span of the multiple-span continuous beam is the middle-span of a three-span continuous beam. The lengths of the unloaded side spans are rapidly determined from the fixed points of the loaded span. And since it is just as easy to obtain the moments of the imaginary three-span beam as those of the fictitious fixed-ended beam, the method of Messrs. Schulze and Rose is not advantageous.

I developed these imaginary three-span beams (after an unsuccessful first attempt, *Transactions* of the Amer. Soc. of Civil Engineers, 1927, Vol. 90, p. 188) in my book "Das Kräfteplan-Verfahren," Alfred Kröner Verlag, Leipzig, 1932.

The same imaginary continuous beams have also been found by Dr. Thomas Kluz in his book "Nouvelle Méthode de Calcul des Poutres Droites Continues, des Portiques et des Cadres Simples," Paris, 1932.

J. D. GEDO.

New York, N. Y.,
Dec. 24, 1934.

Encased Concrete Columns

Sir—The article on encased columns, by Prof. W. S. Lohr, in *Engineering News-Record* of Dec. 13, p. 760, is a step forward in the design of reinforced-concrete columns in so far as the arrangement of the steel and concrete permits each material to receive and transmit the type of stress for which it is ideally adapted.

In the writer's opinion, however, the encased column has three major flaws which were not tabulated in the article. These are:

1. It is doubtful if the fire-resistive covering of precast blocks, not being bonded to the body of the column and completely separated from it by a continuous sheet of expanding steel, would long remain effective under a fire of only average intensity.

2. It is not good practice to place the safety of the entire structure upon the soundness of a single member. Should a longitudinal flaw develop in the steel shell of a lower-storied column, the safety of the structure would be impaired. Such a flaw in the encasement may not manifest itself until the column has received its full working load.

3. The use of the encased column is restricted to the column shaft. At the floor and drop panel it becomes necessary to revert back to present-day methods of reinforcement, which, according to the article, are uneconomical. A radical change in the column type at the point of maximum moment is not ideal for distributing these important stresses.

The writer has made some successful experiments with a type of column reinforcement which embodies all the advantages claimed for the encased column but has none of its disadvantages. This improved column reinforcement contains an inner and an outer spiral group secured at intervals by circumferential hoops. Each spiral group is composed of a plurality of bars, spaced just far enough apart so as to permit the free passage of the maximum aggregate. All the bars of a group spiral in the same direction, the two groups spiraling in opposite directions. Circumferential hoops are placed at the intersection of the opposing spirals, and the three bars are welded together at the points of their common contact. This cage forms a series of triangles and effectively retains the flow of the concrete. A feature of this type of reinforcement is that it may be carried into the drop panel and floor system and then into the upper column by flaring out alternate spiral bars at the floor and carrying the balance through to the next unit.

JOHN C. SCHULZE.

New York, N. Y.,
Dec. 22, 1934.

ENGINEERING NEWS-RECORD

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Editorial and Publishing Offices at 330 West 42d Street, New York

ENGINEERING NEWS-RECORD is a consolidation of Engineering News and Engineering Record, effected in 1917. The Contractor was consolidated with Engineering News-Record in 1918.
Engineering News was founded in 1874 by George H. Frost, as The Engineer and Surveyor, which title subsequently became The Engineer, Architect and Surveyor, then Engineering News and American Railway Journal and finally Engineering News, under the editorships of D. McN. Stauffer, A. M. Wellington and Charles Whiting Baker.
Engineering Record was established in 1877 by Henry C. Meyer as The Plumber and Sanitary Engineer. The name was subsequently changed to The Sanitary Engineer, Engineering and Building Record, and, finally, to Engineering Record. During his ownership of the paper Mr. Meyer was directly responsible for the editorial policy. John M. Goodell became editor of the paper in 1902 and was succeeded in 1913 by E. J. Mehren.
E. J. Mehren became editor of ENGINEERING NEWS-RECORD at the time of the consolidation in 1917, and was succeeded by Frank C. Wight in 1924. In July, 1928, F. E. Schmitt was appointed editor.

January 3, 1935

Last Call

VALUABLE RETURNS are being received in reply to the public-works question slip published in our Dec. 20 issue. In order that the construction industry may contribute its broadest experience and judgment to the day's most important problem, it is important that every branch of the field be fully represented. The question slip is therefore repeated this week as a second and last call, on page 27 of the Construction Reports section, the fifteenth page following. If you have not already filled it out please do so today. Only a few minutes are needed to check the questions and mail them to Editor *Engineering News-Record*, Room 2804, 330 West 42d St., New York City. Your views on the value of the public-works campaign and how it may be made most effective can be of vital service.

Spreading Knowledge

THAT VIGOROUS PROMOTION of the construction code is essential before the code will be adequately known and appreciated has become unmistakably evident. At present there is doubt and grumbling about the code in many parts of the construction field. The hostile element includes not only those who might be hit by code enforcement but even men of high standing in the field, whose faith has been destroyed by lack of enforcement and the difficulties of administration. It is fair to say that such complaints and doubts themselves are testimony to the fact that the industry has much to gain through self-government. But the important present teaching is the need of active promotion before the new institution of supervised self-regulation can obtain full recognition. The code authorities, their friends and supporters and all associated bodies have the obligation of spreading knowledge concerning the code—and therewith also leading to its more active enforcement. It is in this direction that the recent Knoxville meeting, an innovation in NRA history, made its major contribution. As the first attempt to carry the code message out among those who are directly concerned, the meeting recorded a complete success. It made a beginning in an educational movement which, if continued, can hardly fail to establish the ideal of self-regulation in a position of full recognition.

Too Great a Burden

ACCIDENTS place a tremendous financial burden on the construction business. As pointed out elswhere in this issue, the industry paid in excess of $60,000,000 for workmen's compensation insurance in 1929 (the last year of complete records), and constant increase of rates since that time indicates further rise in the total of losses. Ignoring for the moment the humanitarian side of accident prevention, an important opportunity to reduce construction costs has apparently been overlooked. Complaints are heard that the cost of code administration is more than construction can bear, yet the $3,000,000 code budget is but a small item compared with our annual cost of construction accidents. Many contractors take the attitude that they are not interested in the cost of accidents because the financial burden is passed on to the owners, and that the cost of insurance does not affect competitive bidding. This attitude is wrong. Every contractor is personally interested in reducing costs, since low costs assure a larger construction volume. Insurance companies are interested mainly in scaling up rates to meet increasing losses, and labor in adequate insurance protection; the owner is helpless in the situation. Thus, the contractor bears the ultimate responsibility for checking the rising cost of accidents. The simple and effective safety program for contractors outlined in the present issue, by helping to reduce accident frequency and cost, can lighten what at present is too great a burden on construction.

Beginning a Long Task

NO ONE concerned with development problems, with public administration, with water, land or power can afford to overlook the remarkable report of the Mississippi Valley Committee, issued this week. He is certain to find many facts and views that bear vitally on his interests. However, like the report of the National Resources Board (*ENR*, Dec. 20, 1934, pp. 800-803), it ranges over so broad a field as to leave the reader dismayed. Like that report, also, it brings together in a confusing way condensed factual results and somewhat academic discussions of philosophy and policy. As a whole the report reveals problems of remarkable size and complexity, many of them reflected more clearly in the numerous individual conclusions scattered through the body of the report than in the general discussions. Apart from definite findings on proposed projects, the committee's suggestions that waterway improvement should rest on tolls, that certain contemplated river improvements are probably unjustified, and that flood protection and related works should be built only if local interests pay for local benefits, point straight along the line of sound progress. Less factual grounding appears to underlie the ambitious proposal that a public power distribution network be established and that extensive rural electrification be undertaken. In connection with these novel suggestions by the way, the committee wisely makes the reassuring statement that its power plan is not hostile to private enterprise but contemplates entire cooperation between private and public power elements. As to the future, the report demonstrates that intensive continuing effort is necessary in study of nat-

ural resources and their relation to human requirements. We have only begun a long task in this field, a task that involves organizing for thorough collection and study of data and wise planning and budgeting of improvement works.

Self-Liquidating Waterways

IT IS ENCOURAGING to find the Mississippi Valley Committee upholding the principle that those who benefit from the use of an artifical waterway should share in paying its cost. The committee, in fact, carries this progressive view so far as to question the economic soundness of some existing waterways and projects upon which the government is spending large sums. It recommends that expenditures on some projects be curtailed until more is learned of the value of the work already done. Before any new work is undertaken, the committee declares, the economics of the project should be studied more thoroughly than has been the case with many projects in the past, and unless the benefits are sufficient to make it possible for beneficiaries to return a reasonable part of their profits to the government in tolls the project should not be undertaken. That is sound economics. Too many of our present artificial waterways have no economic justification and in fact are subsidies to great corporations that are their chief users—steel and oil companies, for example—to say nothing of the wealthy yacht owners who cruise the sheltered channels of the Atlantic Coast. When the St. Lawrence waterway comes up again for consideration, it should be approached on the basis of creating a self-liquidating transportation facility. If it is able to produce the large savings in transportation costs claimed by its proponents, it can be made self-liquidating through tolls. If it cannot, then it should not be built.

A Mistake That Should Be Corrected

WHEN construction of the Grand Coulee power project under the Recovery Act was undertaken, more than a year ago, immediate re-employment was the dominant objective, and the details and purpose of the project were given little thought. Soon, however, doubts arose in the public mind concerning its soundness, especially when it became known that the project had not been studied either as to design or as to ultimate service value. As the facts are coming to be better understood, they rank Grand Coulee definitely as the prime blunder of the public-works campaign.

The present Grand Coulee dam is not the one that was under study for years as part of the Columbia Basin irrigation project, which was to be served by a high dam providing a pumping forebay and a source of power for lifting the irrigation water to the canal system. The earlier project contemplated a dam 350 ft. high, while the 150-ft. dam now being built is too low for irrigation service and will lack the power market that would be furnished by the pumping requirements and the needs of the irrigated farms and towns. The "low dam," designed after the fact to fit the President's allocation of $63,000,000, is purely a commercial power source.

Considered as a business enterprise, then, the Grand Coulee project of today depends for its justification on the present and prospective power market in the Northwest. Studies of this market have been discouraging. The three states of the Northwest already have ample power resources developed and in service, and a further addition will shortly be made by the government's Bonneville plant. Since the needs of the region thus are supplied for a long time ahead, the Grand Coulee plant, adding to a market already oversupplied by hundreds of thousands of kilowatts, is an economic absurdity.

Assuredly, a power plant built in the face of the certainty that it will be unable to sell its output is better not built. But this particular power plant is even worse than a dead loss, for as a rival of Rock Island and Bonneville it will be a constant temptation to indulge in competitive business-seeking at cut-throat prices, a process that inevitably follows over-capacity building in any industry and that furnished the prime motive for setting up the NRA code system.

The "high dam" is an undertaking of quite another kind. It is an essential and permanent element of the irrigation scheme, and since this latter in due course is sure to be built, there is good warrant for building the dam now, when unemployment needs are serious, even though it may not be put to immediate use. Installing power equipment may be deferred until need develops. The case was well stated at the meeting of the Northwest Regional Planning Conference two weeks ago. (*ENR*, Dec. 27, 1934, p. 837): "Public interest would be better served by undertaking at this time the construction of a high dam, with the power installation to be added later as warranted by the growth of the market, rather than by building the low dam now, primarly for power production."

In short, the Grand Coulee project as it stands today is an economic error of first magnitude. And further, because of the mistaken decision to build the low dam it is complicated by technical doubts not easily dismissed. The low dam has been planned for later conversion into the high dam by building against its lower face an additional section, or auxiliary dam, extending 200 ft. above its crest. Such raising, an operation of unprecedented dimensions, goes well beyond the range of recognized engineering procedure. While technical skill may overcome them, as it has overcome many other grave difficulties, yet the hazard of the operation is one that should not needlessly be assumed. The proposed raising would result in a two-piece dam, a structure whose continuity is broken by a great joint surface extending from the foundation to the water face. Because experience has taught that joints are objectionable, builders of dams make every effort to obtain a structure free from joints and planes of weakness. Especially in a concrete wall 350 ft. high over which extreme floods may send a thundering cataract of water flowing 20 ft. deep, structural integrity should be the first objective.

The defects of the project arise from the fact that it is not a project at all, having never been studied or planned, but merely represents $63,000,000 worth of power dam (*ENR*, Nov. 29, 1934, p. 676). Before more money is sunk in this wildcat investment the blunder should be corrected by abandoning the low dam power scheme and building instead the high dam—for the present, at least, without power. If the money for the greater project is lacking, or if the irrigation plan is judged to be too remote to give any support to the undertaking, it is better to abandon the work entirely than to continue useless expenditure.

CURRENT NEWS

Governors Offered PWA Aid in Planning Works Legislation

PRESIDENT ROOSEVELT has written letters to the governors or governors-elect of each state, offering the assistance of the PWA in preparing legislation which would enable municipalities and other public bodies to gain fuller benefit of whatever additional public works program is authorized in the coming session of Congress. In his letter, the President offered several general suggestions to the state, covering the simplification of procedure for bond issues, the delegation of greater powers to municipalities to issue bonds, slum clearance and low-cost housing, rural electrification, and the creation of municipal improvement authorities.

The legal division of the PWA, which already has assisted several states, at their request, in the preparation of legislation designed to facilitate and expedite the public works program, was designated by the President as the federal agency which will assist, upon invitation, the states in the formation of their legislative programs.

The general suggestions offered by President Roosevelt, in a typical letter follow:

(1) Simplification of the procedure for the authorization and financing by municipalities of public-works projects, for example, by eliminating the requirement for an election and in lieu thereof substituting a permissive referendum on bond issues, by shortening the periods of notices before such referendum elections, and by permitting the sale of bonds privately to the Federal Government.

(2) Conferring of additional powers upon municipalities to undertake public-works projects and issue bonds to finance the same, including the relaxing of statutory limitations upon taxing power to pay debts, and the delegation of a broader authority to municipal officials to make such contracts with the Federal Government as are deemed in the best interests of the municipality.

(3) Creation of municipal improvement authorities without power to tax, but with power to issue bonds payable solely from the income of revenue-producing improvements, such as water, sewer, and electric light and power systems.

(4) Authorizing municipalities to engage in slum clearance, including condemnation of necessary lands, and the construction, operation and maintenance of low-cost housing, to make contributions therefor, and to enter into contracts with the Federal Government in connection therewith.

(5) Providing for the creation of non-profit public benefit corporations or agencies to provide for the electrification of rural communities with the assistance of the Federal Government.

(6) Validation of bonds and other obligations heretofore issued by municipalities for public-works projects and sold to the Federal Government.

Ten Miles of Tunnel Awarded By Metropolitan District

Award of contracts totaling $2,812,080 for building ten miles of tunnels on the distribution system of the Colorado River aqueduct was made on Dec. 21 by the board of directors of the Metropolitan Water District of Southern California. For building the Monrovia tunnels Nos. 1, 2 and 3, the directors awarded a contract to the West Construction Company at a bid of $2,190,000. L. E. Dixon, Bent Brothers, and Johnson were awarded the Pasadena tunnel contract at $621,180. Work is expected to start within sixty days.

The Monrovia tunnels will be in the foothills between and to the north of Glendora and Monrovia. The Pasadena bore, 2 1/3 miles long, will pass beneath Mountain St., from Hill Ave. to Sunset Ave. The tunnels will be 10 ft. in interior diameter and are to be concrete lined.

Am. Soc. C. E. Votes Amendment To Professional Code Ethics

By a vote of 3,152 to 703 members of the American Society of Civil Engineers have amended the society's Code of Ethics to include a section applying to salaried engineers accepting other work. To the present code, which begins "It shall be considered unprofessional and inconsistent with honorable and dignified bearing for any member of the American Society of Civil Engineers," has been added the following seventh section: "To use the advantages of a salaried position to compete unfairly with other engineers."

Nashville to Start $2,000,000 of PWA-Financed Schools

Among 1935 municipal projects is a $2,000,000 public school construction program in Nashville. It will include thirteen new buildings and additions, all PWA projects. Money for construction, secured by recent sale of city bonds, is on deposit. Advertisements for bids on four of the buildings is to be made about Jan. 1. Only four projects have been definitely established. East Nashville junior high school, $200,000; Waverly-Belmont section junior high, $187,000; Sylvan Park elementary school, $85,000; Negro High School, $156,000.

Highway Relocation to Start In Norris Dam Reservoir Area

The relocating of roads in the Norris Dam reservoir area will be started by the TVA during the month of January, according to Frank Webster, TVA highway engineer. The work will begin on the secondary roads that will be flooded out by the reservoir and in February a contract will be let for the rebuilding of ten miles of U. S. Route 33, the only main highway which will be relocated.

Government Allots State Highway Funds For Coming Year

APPORTIONMENT of $125,000,000 for federal aid to the states in highway construction for the fiscal year beginning July, 1935, marked the resumption of the old policy of federal highway aid. The apportionment was made by Henry A. Wallace, Secretary of Agriculture, on Dec. 27 under the authorization contained in the Hayden-Cartwright Act of June 18, 1934.

Secretary Wallace, in making the apportionment, called attention to the possibility of reduction of a state's apportionment through the operation of the provision in the Hayden-Cartwright Act relative to the diversion of gasoline taxes and other taxes on motorists. The act provides that federal aid for a state's highways shall be reduced unless the state uses for highways at least the amounts provided by law on June 18, 1934, for that purpose from the state's gasoline and motor vehicle taxes and other special taxes on motor vehicle owners.

The apportionment is as follows:

State	Allotment	State	Allotment
Ala.	$2,604,320	Neb.	$2,581,663
Ariz.	1,781,347	Nev.	1,595,501
Ark.	2,142,723	N. H.	609,375
Calif.	4,756,959	N. J.	1,675,751
Colo.	2,288,811	N. M.	1,999,299
Conn.	791,253	N. Y.	6,150,106
Del.	609,375	N. C.	2,938,657
Fla.	1,655,723	N. D.	1,960,162
Ga.	3,168,221	Ohio	4,565,435
T. H.	609,375	Okla.	2,947,521
Idaho	1,531,162	Ore.	2,044,633
Ill.	5,160,696	Pa.	5,348,062
Ind.	3,087,613	R. I.	609,375
Iowa	3,231,718	S. C.	1,692,896
Kan.	3,317,054	S. D.	2,036,775
Ky.	2,304,143	Tenn.	2,638,159
La.	1,776,939	Tex.	7,777,504
Me.	1,090,167	Utah	1,410,752
Md.	1,025,870	Vt.	609,375
Mass.	1,741,877	Va.	2,278,475
Mich.	3,837,292	Wash.	1,949,957
Minn.	3,423,306	W. Va.	1,356,793
Miss.	2,196,524	Wis.	3,045,557
Mo.	3,800,856	Wyo.	1,559,444
Mont.	2,560,449		

Los Angeles Seeks to Extend Law To Get RFC Flood Control Loan

An amendment to the Los Angeles County Flood Control Act to make it possible for the flood control district to borrow money from the federal government for financing flood control works in the La Crescenta-Montrose areas will be asked of the California Legislature in January, 1935. The proposed amendment will seek to overcome legal objections of the RFC to making a loan to the district under the present laws. Owing to the recent defeat of a proposed bond issue for flood control works, the flood control district has no collateral to offer for an RFC loan. It is estimated that about $4,000,000 is necessary to build the control works needed to protect the La Crescenta-Montrose area from flood damage. The flood control district, in the meantime, has set up emergency patrol districts with engineers and apparatus available for use in combatting flood conditions.

Washington Notes

By Paul Wooton
Washington Correspondent

Marriner S. Eccles, the new governor of the Federal Reserve Board, formerly president of the Utah Construction Co., is an advocate of a large public works program. He occupies a strategic position. Support from the Federal Reserve is essential to a spending program.

An additional authorization of $100,000,000 for flood control on the lower Mississippi River will be asked at the new Congress.

An unemployment insurance law is almost certain of enactment by the new Congress. It will not be far-reaching in its scope but will be passed as an entering wedge. A more thorough-going old-age pension law is expected to find its way to the statute books.

Up to the end of the year TVA had expended $24,000,000 for materials and $11,000,000 in wages. Half of the amount spent for materials went outside of the valley. Purchases were made in 35 states.

In the opinion of some experts the Buzhards' Roost project of Greenwood County on the Saluda River will be a better yardstick than the TVA project, in that it is not complicated by a variety of operations, as is the government's development in the Tennessee Valley.

Because of the fundamental questions involved officials in Washington are showing great interest in the forthcoming proceedings in the U. S. Court for the Southern District of West Virginia involving the Hawks' Nest project of the Electrometallurgical Co. on New River near the head of the Kanawha. The Federal Power Commission contends that this project affects interstate commerce and must be licensed under the water power act.

Many of the direct loans to industry have gone to contractors now that regulations have been liberalized to allow substantial purchases of equipment, in addition to the funds needed for working capital, more loans to those in the construction industry are expected.

Unexpected PWA balances are being impounded temporarily, apparently for reallotment to work relief. President Roosevelt's active personal interest in the 1935 public works program is indicated by his letter to governors requesting that they urge their legislatures to remove legal obstacles to the issuance of bonds to cover state or municipal share of costs of public works projects.

Construction Work to Start on First Dam in Muskingum Project

Construction work is scheduled to start at once on the Tappan Dam in Harrison County, Ohio, the first unit in the $35,000,000 flood control program being carried out in the Muskingum Valley under the direction of the Corps of Engineers. The contract was let several weeks ago to the Sammons-Robertson Co., Huntington, W. Va. The contractor has already moved equipment to the site.

Rules for Bid Depositories Issued by Code Authority

Copies of the minimum requirements for rules and regulations for the operation of bid depositories for general building contractors have been sent out to all of the divisional code authority's state administrative agencies by Louis W. Hickey, executive manager of the divisional code authority for general contractors. The rules became effective and mandatory on Jan. 1. The authority approved the bid depository systems now in operation in the following jurisdictions: Arizona, Arkansas, Colorado, Connecticut, District of Columbia, Georgia, Iowa, Kentucky, Louisiana, Maryland, Michigan, Missouri, Nebraska, New York, Pennsylvania, Washington and West Virginia.

Although the bid depository plan is designed principally for application to competitive bids submitted on building construction projects amounting to $1,000 or more, Executive Manager Hickey states that if the state administrative agencies and/or the highway and heavy contractors deem it advisable that these divisions have bid depositories, such depositories may be operated in accordance with the approved rules and regulations, but that in all instances the divisional code authority must be advised.

"State administrative agencies shall, insofar as is reasonably possible," Mr. Hickey states, "notify all building contractors, awarding authorities, owners and engineers, by use of press, trade journals and other periodicals, or by mail, that this bid depository plan has been established and that these minimum rules and regulations have been put in force covering all building contractors. After such notice has been given, it shall be mandatory upon the building contractor to properly file duplicates of all competitive bids as described in the rules."

Provisions of the plan for bid depositories will be outlined in next week's issue.

Decentralization Of PWA Advocated By Sec. Ickes

(Washington Correspondence)

GREATER decentralization of the PWA organization to speed this year's public works program is planned by Secretary Ickes. It is the Administrator's intention to throw more responsibility on the states.

"By greater decentralization," he said, "we can act much more rapidly in approving projects." Administrator Ickes' statement was made without reference to the total appropriation that President Roosevelt may recommend for public works. Administrator Ickes defended the meticulous care with which the public works program was administered during its first year to prevent graft and waste. "I am willing," he said, "to meet criticism on that score until the end of time but in the light of experience I can see now where it would have been desirable to build up a bigger organization in the states to begin with. I had no conception of the magnitude of this job."

He explained that after eighteen months of operation the PWA now has trained men that can be detailed to regional or state offices. Pointing out that this personnel was not available when the emergency public works program was undertaken, he said that he was proud of the character of the organization.

Both low-cost housing and subsistence homesteads should be continued and expanded, in Secretary Ickes' opinion. Concerning proposals for a reduction in materials prices and wage rates which were one of the issues in his recent controversy with Administrator Moffett, of the FHA, the secretary said that he expects to take this up, assuming that housing is included in the public works program.

Washington Plans to Extend State Control To Secondary Highway System

A NEW PLAN for state highway development in the state of Washington, providing complete control over all road construction and maintenance, and the setting up of a new system of allocating highway funds, has been announced by Governor Martin, to be transmitted to the 1935 legislature with his recommendation. The new program is the conception of the state administration for instituting a more modern, efficient and economical motor vehicle regulatory and highway administrative set-up. The plan was prepared by Lacy Murrow, director of highways, in conjunction with other state and highway department officials.

State highway control, according to the proposed plan, would be vested in a state highway budget board of three members, appointed by the governor, who would have authority to allocate highway funds. The plan would abolish county highway engineers and country road-building and maintenance units. Although all highways would be under state control, two separate systems would be maintained: (1) a primary system and (2) a secondary road system. The latter would consist primarily of the present county roads. The primary state system would include about 4,500 miles of highway as compared to 3,800 miles at the present time. All other public highways and roads in the state, outside of incorporated cities and towns, consisting of about 39,000 miles of road, would become the secondary state system.

Financing plans

All highway funds, amounting to about $13,000,000 annually from the gas tax and license fees, with a possible additional $1,000,000 from county road levies, would be placed in the hands of the budget board for allocation. The new plan provides that the board set aside a certain amount for the primary system and allocate this on the basis of highway routes. The funds for the secondary state road system would be allocated by counties. The board would conduct hearings, at which county commissioners would recommend projects within their counties and give estimates of costs and indicate the merits of these projects.

A.G.C. to Hold Annual Meeting At Washington, Jan. 28-30

The sixteenth annual convention of the Associated General Contractors of America will be held in Washington, D. C., Jan. 28-30. Consideration of legislation affecting the codes, the public works and federal housing programs will occupy first place in the program of the meeting. Every possible means of reviving the field of private construction will be probed, according to preliminary announcement. A sounding out of the general contractors' sentiments in regard to the construction code, Chapter II, will also be part of the program. Special divisional meetings of building, highway, heavy and railroad contractors will be held in addition to the general sessions. Nick F. Helmers, of St. Paul, has been re-nominated for president of the association and A. W. Merchant, of Providence, has been re-nominated for vice-president at large.

Engineering Council to Hold Annual Meeting in Washington

Addresses by the presidents of the major engineering societies will feature the program at the annual meeting of the assembly of the American Engineering Council to be held in Washington, D. C., Jan. 10-12. The business session on the first day will consist of meetings of the various committees of the council.

An address on "The Outlook for Durable Goods Industry" will be presented by Ralph E. Flanders, president, A.S.M.E., on the second day, to be followed by an address on "Trends in Construction," by A. J. Hammond, past president, A.S.C.E. On the last day of the meeting an address will be given by L. J. Fletcher, past president, American Society of Agricultural Engineers, on "Development of National Resources." Each of these three major addresses will be followed by a symposium presented by government officials from corresponding fields of activity.

Engineering Council Would Add Engineers to Federal Service

Active efforts by American Engineering Council to develop opportunities for the employment of engineers in the government service has resulted in the appointment of C. H. Crawford, of New York, to the staff of the Council in Washington to carry on this service in behalf of the American Society of Mechanical Engineers, American Society of Civil Engineers, American Institute of Electrical Engineers and American Institute of Mining and Metallurgical Engineers.

A canvass by the Council of government departments and agencies revealed not only that there are numerous openings for the employment of engineers from time to time but many others which engineers frequently can fill to better advantage than persons of other types of technical training or no technical training whatever. By personal contacts throughout the government establishment in Washington Mr. Crawford is informing officials of the desirability of enlisting the services of engineers for activities of much wider scope than is ordinarily associated with the engineering professions by personnel officers.

Road Builders Convention To Feature Broad Program

The annual convention of the American Road Builders Association which will be held in Washington, D. C., January 22-25, will include addresses which cover topics ranging from the consideration of highway work for unemployment relief to such technical considerations as the economy and use of timber for bridges. Speakers at the opening general session will include Melvin C. Hazen, president, board of commissioners of the District of Columbia; Senator Carl Hayden of Arizona; Thomas H. McDonald, chief of the U. S. Bureau of Public Roads, and Frederick A. Delano, vice-chairman of the National Resources Board.

Some of the subjects to be considered at the technical sessions include "Indicated Needs in Grade Crossing Elimination," "Latest Developments in Secondary Road Surfaces," "Economic Waste in Substituting Hand Labor for Modern Machinery," "Timber Bridge Structures, their Economy, Safety and Utility," "Simplified Practice as a Tool for the Road Builder," and "The Highway Industry's Responsibility for Traffic Safety."

A feature of the convention will be several papers devoted to the highway work in Mexico and the plans for the Pan-American highway. A Pan-American reception is planned for the second evening at which J. L. Gonzalez, director general Mexican Highway Commission, will preside.

STEEL WORK ADVANCING WEST ON THE SAN FRANCISCO BAY BRIDGE

Steel truss erection on the San Francisco Bay Bridge is advancing rapidly from the east shore and the view shows ten of the 292-ft. deck spans completed. The piers between the erected spans and Yerba Buena Island provide for four more deck spans of about 290-ft., five 510-ft. through spans and a 1,400-ft. cantilever with 512-ft. anchor arms. Paralleling the approach is the existing rapid transit mole and trestle ending in a ferry terminal.

On the near side of the island is shown the work at the west portal of the 580-ft. tunnel and the anchorage for the suspension span. The tower in the foreground is 480 ft. high and will support the east end of the east half of the 2,310-ft. twin suspension spans across the west channel.

Colorado Basin States Propose Conference with Arizona

Governor Blood of Utah has proposed in a letter to Governor Moeur of Arizona that a conference of all of the seven states in the Colorado River Basin be held to carry forward the discussion of Arizona's rights to storage space in the Boulder Dam reservoir and the general allocation of Colorado River water. This suggestion for a conference is a direct outgrowth of the meeting held in Washington Dec. 17 (*ENR*, Dec. 20, 1934, p. 804) when the six signatory states to the Colorado River compact protested the proposed contract with the federal government which would allow Arizona the right to 2,800,000 acre-ft. of reservoir storage. Following the Washington meeting Secretary Ickes declined to sign the contract, requesting the states to hold a further conference and to show a "spirit of more cooperation" in settling the question of allocation of water from the Colorado River.

As chairman of the meeting held by the six states in Salt Lake City Oct. 3, Governor Blood requested Arizona to send representatives to a meeting of all of the states "to get together in a friendly way and calmly discuss the issues."

Chicago Sanitary District Would Sell Canal to Government

At a public hearing before Lt. Col. Donald H. Connolly, Corps of Engineers, U. S. Army, district engineer at Chicago, held Dec. 19, the Sanitary District of Chicago argued that the government should reimburse the District for the 36-mile main drainage canal, the Sag Channel and others which it constructed essentially for the joint purpose of a ship canal and for carrying 10,000 sec.ft. of water from Lake Michigan to dispose of its sewage by the dilution method. The supreme court's limitation of diversion to 1,500 sec.ft. made it necessary for the District to build treatment plants and, the District argues, the canal is no longer of great value to it for sewage disposal purposes. The brief of the District states the reproduction cost of the navigation canals and structures is $90,607,000. The apportionment is as follows: Main channel, $52,545,000; Calumet-Sag channel, $18,332,000; Chicago River, South Branch, $18,894,000; Calumet Rivers, $836,000.

The District pledges itself in the brief to use the money to build sewage disposal systems, thus complying with the decree of the Supreme Court which requires the abandonment of the dilution method.

Opposition appeared at the hearing from the lake states, four attorneys being present. Their contention was that this proposal to sell the channels is an attempt to avoid the requirements of the Supreme Court regarding diversion. They expressed the fear that should existing ownership of the channels be changed the decree of the court limiting diversion would not obtain on the federal government. Adjournment of the meeting until Jan. 15 was announced by Colonel Connolly to give the lake states attorneys a chance to examine the brief and prepare opposing testimony. This delay will probably prevent any recommendation from the War Department being made to the next session of Congress.

Southwest Engineering Progress

Water Control and Development Work Active in Texas—Organization Started for the $45,000,000 Brazos River Project—Maverick Water District Improved—State Planning and Relief Commissions Active

(Special Correspondence)

DALLAS, TEX., December 26—Work on the conservation and control of water resources of Texas is a major engineering activity in the state at the present time. This work includes improvements on several existing irrigation and conservancy districts, which are becoming more active as agricultural conditions improve, the organization and planning for new development projects and the federal river and harbor program.

The Brazos River watershed project, which provides for the ultimate control and use of the resources of this river system, is being organized. This project, which involves an estimated final expenditure of almost $50,000,000, is to be undertaken by a district established by the last legislature. Present plans for carrying out the work contemplate the securing of PWA financing. In addition to water utilization, a more recent proposal has been made to extend the program by $15,000,000 to be used for soil erosion control.

Unofficial reports from Washington indicate the possibility of a duplication of the Tennessee Valley Authority program along the Rio Grande River. The basis for this belief was an additional PWA allocation of $100,000 for extending the foundation for the Caballo Dam on the upper section of the river in New Mexico, anticipating the desirability of increasing the height of the dam at a later date for the development of power.

State agencies active

The Texas State Planning Board is actively at work on studies contemplating the orderly development of the natural resources of the state. Present opinion tends to reinforce the work of the board and considers it a powerful factor in the development of coordinated plans.

The Texas Reclamation Department is preparing a complete report on rainfall intensities and duration for Texas and adjoining territory, which will be of unusual value in the present and future studies for water development programs. The Texas State Relief Commission is actively revising the policies of local committees where work relief has not been a general policy, and a large amount of this type of work should develop throughout the state the coming months.

Texas engineers who have been connected with PWA projects are, as a general rule, favorably impressed with the calibre of the engineering inspectors placed on these projects by the PWA organization. Some instances have developed where lack of engineering experience has handicapped the work and resulted in some friction, but these cases are relatively few.

Navigation improvement

The dredge, "New Orleans," has started work on the 16-mile channel intended to bring deep sea shipping from the Gulf of Mexico to Brownsville. This work, which involves the moving of 17,000,000 cu.yd. of material financed by a $2,694,000 PWA loan, is the realization of a project which is a half century old. In connection with this navigation improvement, the federal government has practically completed a $2,600,000 jetty project at Brazos-San Diego Pass. The improved port at Brownsville is expected to handle extensive tonnage of farm products and oil from the lower Rio Grande Valley, and a considerable volume of tonnage out of Mexico.

The International Boundary Commission has opened bids for flood control work at Nogales, Ariz., and the Atlas Construction Co. has started dredging to straighten the lower end of the Arroyo, Colo., in the lower Rio Grande Valley, under a contract which covers 300 workings days. The river rectification work at El Paso, and in the lower valley, is actively under way under the direction of the International Boundary Commission, American Section, and about 12,000 men are employed on the flood control work.

Miscellaneous items

The state highway department recently received bids for projects estimated to aggregate $1,300,000.

The Lone Star Gas Co. has announced an expansion program covering pipe lines, compression stations, etc., estimated at $2,000,000.

Work is actively under way on the $1,000,000 underpass project which connects the principal street of Dallas with one of the main highway routes meeting west of the city.

SOCIETY CALENDAR

AMERICAN ENGINEERING COUNCIL, annual meeting, Washington, D. C., Jan. 10-12.

AMERICAN ROAD BUILDERS, annual convention, Washington, D. C., Jan. 22-25.

AMERICAN SHORE AND BEACH PRESERVATION ASSOCIATION, annual meeting, Washington, D. C., Jan. 10.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual meeting, New York, Jan. 16-18.

AMERICAN WOOD-PRESERVERS ASSOCIATION, annual meeting, New York City, Jan. 22-24.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Cincinnati, Ohio, May 6-10.

ASSOCIATED GENERAL CONTRACTORS, annual convention, Washington, D. C., Jan. 28-30.

CANADIAN CONSTRUCTION ASSOCIATION, annual convention, Montreal, Que., Jan. 29-31.

ENGINEERING INSTITUTE OF CANADA, annual meeting, Toronto, Ont., Feb. 7-8.

NATIONAL PAVING BRICK ASSOCIATION, annual meeting, Indianapolis, Ind., Feb. 7-8.

NATIONAL BITUMINOUS ASSOCIATION, meeting, Washington, D. C., Jan. 23.

CONNECTICUT SOCIETY OF CIVIL ENGINEERS, annual meeting, New Haven, Feb. 19-20.

NEW ENGLAND ROAD BUILDERS ASSOCIATION, at the annual meeting Dec. 17, elected Louis R. Perini, president, and Joseph A. Tomasello, secretary.

Obituary

ARTHUR LE GRANDE WOOLLEN, for many years consulting engineer for the railroad builder and financier, E. H. Harriman, died at his home in Knoxville, Dec. 20, at the age of 69.

DAVID WALKER LUM, former chief engineer of the Southern Railway, died at his home in Washington, D. C., Dec. 26, at the age of 80. He was born in Newark, N. J., in 1855, attending the Newark Academy in 1873. Mr. Lum began his railroad career in the engineering departments of several smaller railroads in the Middle West, and in 1876 became assistant engineer of the Hackensack River & Bergen Tunnel Improvement of the Delaware & Lackawanna Railroad. He became division engineer of the C. & O. Railway in 1881, and later chief engineer of the same road. In 1904 he became chief engineer of the Southern Railway.

WILLIAM W. MACON, recently editor of *Iron Age* and formerly of the editorial staff of *Engineering Record*, died at New York on Jan. 1. Mr. Macon had been in ill health since 1932, at which time he retired from active work on *Iron Age*, being appointed consulting editor. Mr. Macon was a graduate of the engineering school of Cornell University in the class of 1898. Following graduation he served on the editorial staff of *Engineering Record* until 1905 when he became editor of *The Metal Worker*. In 1911 he was appointed managing editor of *Iron Age* and in 1930 was appointed editor of the paper.

BRYSON VALLAS, general superintendent, New Orleans Sewerage and Water Board, died Dec. 26 at the age of 46. Born in New Orleans he received his education at Ferrell Military Academy and Tulane University. He early entered municipal service as assistant city engineer and later became principal assistant city engineer leaving this position to become engineer in charge of maintenance Louisiana State Highway Commission. In 1925 he returned to municipal work as city engineer of New Orleans. During his régime the beautification and repaving of Canal St. was carried out. In 1931 he became general superintendent of the Sewerage and Water Board. He was first vice-president of the American Society of Municipal Engineers.

JULES BREUCHARD, contractor and engineer, a member of the firm which built the new Croton Dam, and president of the Underpinning & Foundation Co., died Dec. 28 at his home in New York, at the age of 78. Born in New York City, he spent several early years about 1875 in Billings, Mont., where he held a contract for a section of the Northern Pacific Railroad which was being extended to the Pacific Coast at that time. He returned to New York about 1883, and built a section of the new Croton Aqueduct. As a partner in the firm of Coleman, Breuchard & Coleman, he was active in the construction of the new Croton Dam, and several years later, as a member of the firm, Winston & Co., he was active in the construction of the Ashokan Dam. In 1909 Mr. Breuchard organized the Underpinning & Foundation Co., and remained president of this organization until his death. His company carried out several subway contracts in New York and Philadelphia. He was also the president of Decarie Incinerator Corporation.

CONSTRUCTION STATISTICS OF THE WEEK

ENGINEERING awards at $20,150,000 make a good showing for a 4-day week following a 4-day week. Of this total, $3,616,000 is for federal work, $14,589,000 for state and municipal, making a total for public awards of $18,205,000, and $1,945,000 is for private work.

Streets and roads contracts are high, $7,387,000, waterworks $3,249,000, public buildings $3,017,000, earthwork, drainage, waterways $1,866,000.

Among the larger contracts are included: parcel post building at Richmond, Va., $515,000; highway awards by Georgia, $923,000; by Illinois, $1,268,000; two highway contracts by Ohio, $705,000; and awards by Alabama, $568,000. The award by Metropolitan Water District, Los Angeles, Calif., of Monrovia Tunnels 1, 2, 3 and appurtenant works at $2,813,000 is responsible for the high waterworks total. The St. Paul (Minn.) Sanitary District awarded contract 107, Div. C, tunnel construction for sewer, $469,000. Dredging awards include work at Naval Operating Base, Norfolk, Va., $800,000.

New capital for the week is entirely made up of state and municipal bond sales totaling $4,105,000.

CONTRACTS

(Thousands of Dollars)

	Weekly Jan. 1934	Average Prev. 4 Weeks	Week Jan. 3 1935
Federal Government	$15,532	$3,979	$3,616
State and municipal	14,321	15,399	14,589
Total public	$29,853	$19,378	$18,205
Total private	3,542	5,977	1,945
Week's total	$33,395	$25,355	$20,150

Cumulative to date:
1934 . . . $59,588,000 1935 . . $20,150,000

NEW PRODUCTIVE CAPITAL

(Thousands of Dollars)

1934	Week Jan. 3	Cumulative
State and municipal	$4,105	$4,105
PWA allotments, S&M	....	....
RFC loans, S&M	....	....
Corporate issues	....	....
PWA allotments, private	....	....
Total, Non-Federal	$4,105	$4,105
PWA allotments, Federal Constr.	....	....
Total new capital	$4,105	$4,105

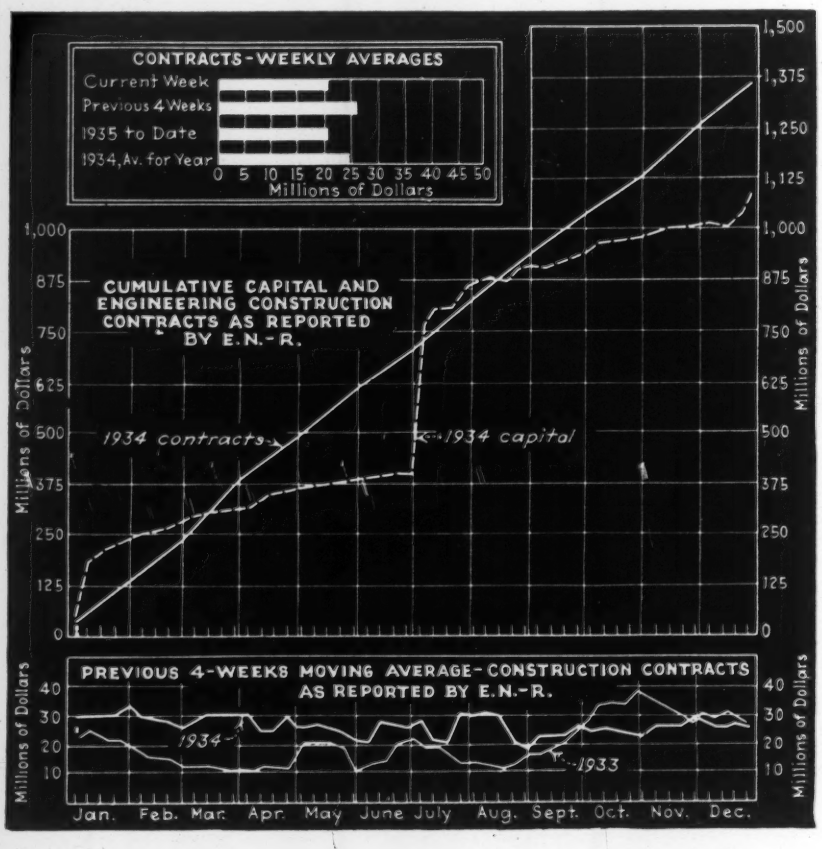
Cumulative to date:
1934 . . . . . $88,515* 1935 . . . . . $4,105,000

*Includes federal allotments for federal work.

Note: These figures include private bonds, and stocks sold for productive purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, including the special highway funds; PWA private loans, and allotments for Federal construction.

INDEX NUMBER

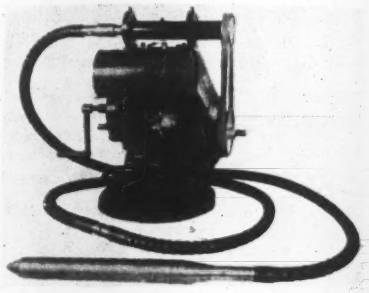
E.N.-R.-Cost	1913 — 100	1926 — 100	E.N.-R.-Volume	1913 — 100	1926 — 100
Jan., 1935	**198.72**	**95.52**	**Dec., 1934**	**165**	**48**
Dec., 1934	201.86	97.03	Nov., 1934	115	50
Jan., 1934	191.26	91.94	Dec., 1933	116	51
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56



Construction Equipment and Materials

Concrete Vibrating Machine Provided with Gas Engine

Two new models of concrete vibrating machines have been introduced by the Superior Construction Equipment Co. Inc., of Indiana, Chicago, Ill. They are both driven by gasoline engines but electric motors may be furnished, if desired. The vibrators are self contained, fully enclosed, and give from 3,800 to 4,000 pulsations per minute. The rotors are carried on ball bearings and driven from the engine by flexible steel shafts encased in moulded



Concrete vibrator driven by 2-hp. gasoline engine.

rubber hose with internal spiral steel bearing and full external steel armor.

Model M-1 is provided with a 2 hp. Lauson engine mounted on a free swiveling base with a 2⅜ in. diameter vibrator. Model M-2 has a 4 hp. Lauson engine, a wheelbarrow mounting with a 12 by 3.50 in. single pneumatic tire, and a 3½ in. diameter vibrator.

The machines are regularly supplied with 14-ft. flexible drive but additional sections may be inserted to give a total of 21 or 28 ft. An important item in design is the fact that the vibrator itself is separable from the flexible drive. Should replacement of vibrator parts or the drive section be required, it is not necessary to replace the total assembly.

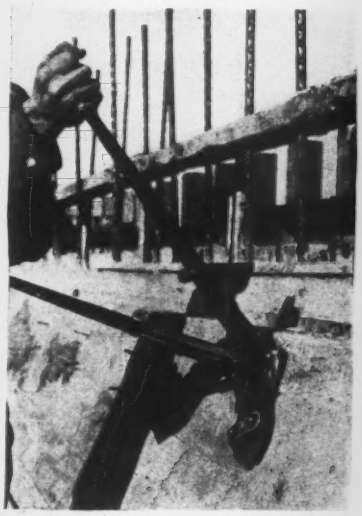
Building Mechanics Exposition To Be Held in San Francisco

Sponsored by the San Francisco Builders Exchange, a Building Mechanics Exposition is to be held in that city during the late spring of 1935, it has been announced by W. H. George, president of the Builders Exchange. The purposes of the exposition, which will be similar to those of the old Mechanics Fair, an annual event in San Francisco for many years up to the fire of 1906, is primarily to afford those in the trade area of the Pacific Coast the opportunity to inspect products used in building construction. At the same time it is designed as an effort to assist in increasing interest in the federal housing campaign.

According to Mr. George, the exposition will embrace all the products and services of the building trades, together with a complete display of building equipment. In connection with the exposition there will be numerous meetings and conventions of architects, engineers, contractors, home owners and similar groups.

Hand Operated Bolt Clipper Has Swiveling Head

The HKP swivel head bolt clipper has been announced by H. K. Porter, Inc., Everett, Mass. The cutting head swivels to any angle on either side of the handle. The device comprises a standard bolt clipper to which has been added a special section joined by a ball and socket joint, with a shoe for holding the cutterhead and a positioning spring to hold the head in the



HKP swivel head cutter.

desired position. The shoe will hold any standard head of a given size, the maker states, and the change from one head to another can be made quickly.

New Equipment in Brief

Copper Coated Metal Siding. The H. H. Robertson Co., Pittsburgh, Pa., announces that Robertson protected metal is now available coated with copper. Robertson protected metal comprises a steel core sheet and asphalt and asbestos coating.

Bronze Valves. A new line of renewable bronze, angle and globe valves has been announced by the Fairbanks Co., New York, N. Y. The valve is provided with a radial seat between the body and bonnet. The disc ring is composed of asbestos compounded with vulcanizing elements.

Spudder Line. Macwhytè Company, Kenosha, Wis., has announced a new "Hi-Lastic" spudder line made of mild plow steel for use in water-well and blast-hole drilling. The new line has three times the stretch of standard drilling line. Although it does not have as much spring as manila rope, the manufacturer claims it has enough to do the work quickly and efficiently and has the advantage of withstanding greater abrasion.

Portable Compressor. A new two-stage, air-cooled portable compressor has been added to the line of portables manufactured by the Ingersoll-Rand Company, New York, N. Y. It is known as Model 85 and is driven by a Waukesha gasoline engine. It has a capacity of 85 cu.ft. per min. at 100 lb. pressure.

Welding Electrode. Fleetweld No. 7, a general purpose heavily coated electrode for welding with shielded arc on mild steel, has been announced by the Lincoln Electric Co., Cleveland, Ohio. The new electrode is designed particularly for high speed and single pass welding. Its arc characteristics are such that it is particularly suitable for welds where fit-up is apt to be poor.

Form Tie. Richmond Screw Anchor Co., Inc., Brooklyn, N. Y., announces the Richmond "One-Inch Break Snap-ty" of concrete ball construction. It consists of a steel tie rod which is notched 1 inch back of the face of the form. After the concrete has set the projecting end of the rod can be twisted off with a special wrench, back of the wall surface. The rod is also provided with washers, at the inside and outside form surfaces.

Telemeter. An electronic relay, by transforming minute electrical currents into useful forces, plays an important part in a new telemetering system recently developed by Bailey Meter Co., Cleveland, Ohio. An electronic relay operated Galvatron receiving element records as many as four factors. The transmitting element consists principally of a variable resistance unit operated by the metering device. In the case of a float operated transmitter for liquid level, a float, by means of a perforated metal tape, operates a sprocket which moves the rheostat. When necessary, an electric bulb is provided to prevent frost from forming on the resistance unit. A vacuum tube system amplifies the transmitted power a sufficient degree to assure positive operation of the equipment.

New Publications

HOW TO MAINTAIN ROADS WITH DOW-FLAKE, Dow Chemical Co., Midland, Mich. 6x9, 56 pages.

MANUAL OF WELDING AND FABRICATING PROCEDURE FOR ING-ACLAD STAINLESS STEEL, Ingersoll Steel & Disk Co., Chicago, Ill. 8½x11, 16 pages.

ROAD MAINTENANCE AND CONSTRUCTION EQUIPMENT, Littleford Bros., Cincinnati, Ohio. 8½x11, 24 pages.

AUSTIN NO. 8 MAINTAINER, Austin Western Road Machinery Co., Aurora, Ill. 8½x11, 4 pages.

WORTHINGTON DIESEL ENGINES, Worthington Pump & Machinery Corp., Harrison, N. J. 8x10½, 8 pages.

GALION ROAD MACHINERY, Galion Iron Works & Manufacturing Co., Galion, Ohio. 7x10, 24 pages.

THE DIESEL ENGINE, STATIONARY TYPE, Ingersoll Rand, New York, N. Y. 8½x11, 20 pages.

GENERAL CATALOG, Traylor Engineering & Manufacturing Co., Allentown, Pa. 8½x11, 94 pages.

DOW CHEMICALS, Dow Chemical Co., Midland, Mich. 8½x11, 104 pages.

THE FORGOTTEN STRUCTURE, Pittsburgh Plate Glass Co., Pittsburgh, Pa., 8½x11, 16 pages. The Cementhide waterproofing system.

SWITCHGEAR, Roller-Smith Co., New York, N. Y. 8½x11, 24 pages.

HARDINGE CONICAL MILLS, Hardinge Co., Inc., York, Pa. 8½x11, 56 pages. Bulletin No. 30.

BUSINESS SIDE OF CONSTRUCTION

December Awards Recede Slightly—Private and Non-Federal Higher

DECEMBER engineering construction awards amount to $101,419,000, of which $23,907,000 represents private work and $77,512,000 public work. Of the public work, $15,915,000 is federal and $61,597,000 state and municipal. Compared with last December this represents lower federal awards and higher state and municipal and private awards.

Added to the year's total which was reported as awards were made, is $82,000,000 representing day labor commitments by the federal government in excess of materials contracts and/or sub-contracts reported on Norris, Joe Wheeler and Fort Peck Dams. Not having a date corresponding to a contract award date for recording these projects in the year's total they have arbitrarily been assigned to January, February and March in amounts of $32,000,000, $25,000,000 and $25,000,000, respectively. The Fort Peck Dam allotment still has a balance of $25,000,000 unassigned as to construction statistics which will be carried over to 1935 and entered when future contracts are awarded or definite decision is made as to how the remaining work, including tunnel lining and power house, will be handled.

The year's total including these federal day labor projects is $1,360,596,000, compared with $1,068,369,000 in 1933, an increase in dollar value of 27.5 per cent. The increase in "structure" volume is 11 per cent after adjustment is made for the higher cost index prevailing in 1934.

Highway awards in December fell below the high volume of December, 1933, while public building awards are considerably higher. Industrial building awards established their highest volume for the year in December. Commercial building awards were low.

Territorially, Middle Atlantic, West of Mississippi and South continue below last year in volume of awards, while New England, Middle West and Far West show gains for December over a year ago. The Middle West and Far West gains are substantial.

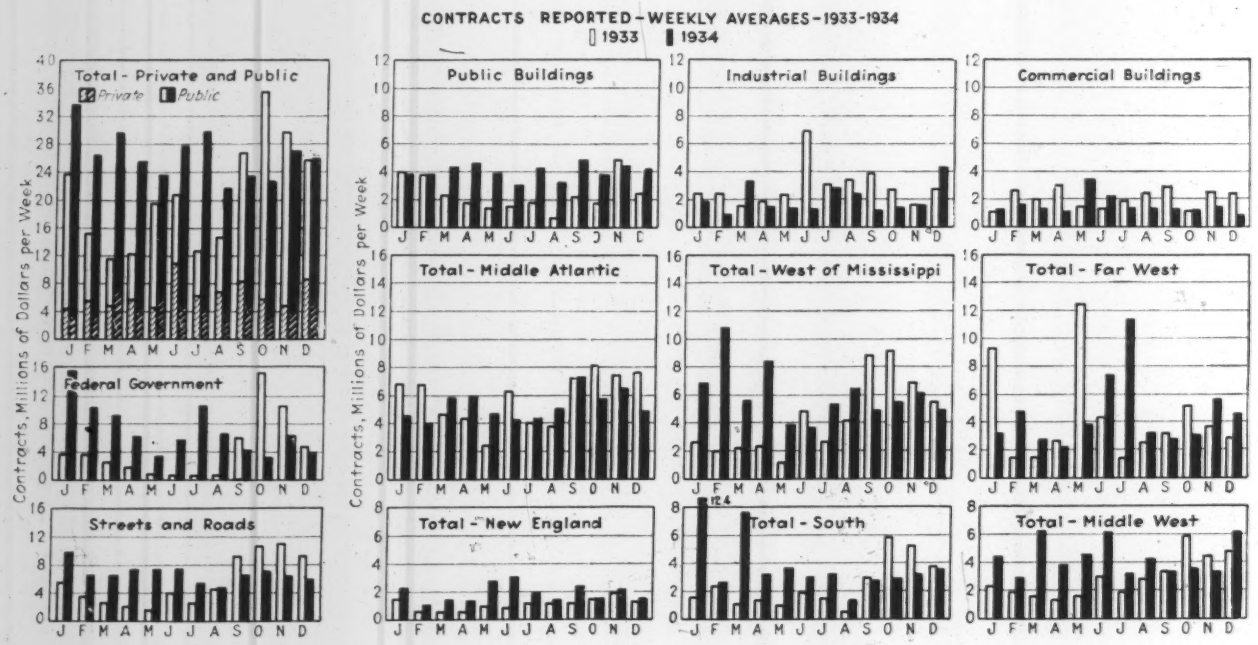
New capital

The municipal bond market made a strong showing in December on sales of construction issues. The total for the month is $83,813,000, which includes $40,000,000 in improvement bonds for New York City and a transfer from PWA fi-

ENGINEERING CONSTRUCTION CONTRACTS REPORTED IN DECEMBER, 1934

Four Weeks—Thousands of Dollars (000 Omitted)

	New England	Middle Atlantic	South	Middle West	West of Mississippi	Far West	United States Dec. 1934	United States Twelve Months 1934	United States Twelve Months 1933	Canada Dec. 1934
Public Works										
Waterworks	1,634	1,001	280	808	1,336	9,032	14,091	92,495	67,263	16
Sewerage	611	775	500	1,617	875	448	4,826	61,068	22,175	..
Bridges, public	415	843	1,191	1,108	797	954	5,308	88,800	80,890	17
Earthwork and waterways	987	263	6,423	499	3,764	1,912	13,848	266,431	136,575	178
Streets and roads	808	4,079	3,385	5,420	5,870	1,738	21,300	345,066	288,258	91
Buildings, public	1,425	6,898	879	1,706	3,717	1,635	16,260	204,185	121,161	2,987
Unclassified, public	240	1,105	88	189	33	224	1,879	61,288	22,817	1,154
Total public	6,120	14,964	12,746	11,347	16,392	15,943	77,512	1,119,333	739,139	4,443
Federal gov't (included in other classifications)	1,113	983	6,638	2,098	3,319	1,764	15,915	360,166	270,866	.....
Private										
Bridges, private	....	....	....	....	....	....	....	10,044	16,941	....
Buildings, industrial	346	1,538	306	12,108	1,270	1,554	17,122	105,192	152,376	153
Buildings, commercial	....	2,163	....	235	515	150	3,063	80,685	106,399	....
Unclassified, private	34	153	1,572	350	906	707	3,722	45,342	53,514	100
Total private	380	3,854	1,878	12,693	2,691	2,411	23,907	241,263	329,230	253
December, 1934 (4 weeks)	**6,500**	**18,818**	**14,624**	**24,040**	**19,083**	**18,354**	**101,419**	.....	.....	**4,696**
November, 1934 (5 weeks)	10,768	32,218	16,066	16,276	30,671	28,149	134,148	.....	.....	4,594
December, 1933 (4 weeks)	5,072	30,348	15,352	18,710	21,845	11,236	102,563	.....	.....	6,083
Twelve Months, 1934	100,432	273,556	214,805	226,571	310,325	234,909	.....	1,360,596	.....	47,927
Twelve Months, 1933	58,594	298,481	123,988	150,693	225,295	211,318	.....	.....	1,068,369	35,406



nancing to private of $3,325,000 in bonds sold through the RFC.

PWA allotments outstanding decreased in December by about $4,337,000 due to the sale of PWA bonds referred to above and an excess of recissions and reductions over new allotments. RFC loans added $22,096,000 to the new capital total. Corporate financing for construction included a $500,000 stock issue and PWA loans of $1,860,000.

Of the PWA financing for state and municipal construction outstanding 70 per cent is in loan and grant or grant allotments. Of these loan and grant or grant only allotments 16.7 per cent of the amount outstanding is for grants only and 83.3 per cent for loans and grants. At the end of the first six months of this year the ratio was 12.1 per cent of outstanding allotments in grants only and 87.9 per cent in loans and grants. The increased percentage of grants only is doubtless a reflection of the improved municipal bond market.

Materials

Cement—Cement shipments in November totaled 5,664,000 bbl., an increase of 26.9 per cent over November, 1933. Production showed an increase of 23.7 per cent and stocks at the mills 1.9 per cent over the same period last year. The ratio of production to capacity in November, 1934, was 26.2 compared to 29.3 in October and 21.2 in November, 1933.

Steel—The operating rate of steel companies has made consecutive gains during December of 0.7 points or 2.5 per cent for the first week of December over the last week in November, 3.9 points or 13.5 per cent for the second over the first week of December and 1.9 points or 5.8 per cent and 0.6 points or 1.7 per cent over the respective preceding weeks. The operating rate of steel companies having 98.7 per cent of the steel capacity of the industry as reported by the American Iron and Steel Institute was 35.2 per cent for the week ending December 31, 1934, compared with 34.6 one week ago, 28.1 one month ago and 31.6 per cent one year ago.

Bookings of fabricated structural steel recovered markedly during November, according to preliminary reports received by the American Institute of Steel Construction. Reports from 65 per cent of the industry indicate that the volume this month was 30 per cent larger than the bookings for October, 10 per cent larger than the average bookings for the third quarter of this year, and 12 per cent larger than for November, 1933.

Although the shipments of fabricated structural steel noted a decline from the previous month, they are still above the shipments of the third quarter, and 40 per cent larger than the average monthly shipments during the first half of the year.

Owing to the seasonal drop in bookings following Labor Day, and the continued heavy shipments during the fall, the backlog of the industry is now probably 25 per cent less than it was at this time last year.

Lumber—Due largely to reaction in December, 1933, from the November peak of new business preceding the first publication of minimum cost protection prices under the Lumber Code, orders reported as booked up to December 21, 1934, are nearly 70 per cent heavier than those of corresponding weeks of 1933. Those received during the week ended December 15, 1934, were, however, no more than maintaining the average of recent past weeks and production was lower than for any week of 1934 since January, except the week of July fourth, according to reports to the National Lumber Manufacturers Association from regional associations covering the operations of leading hardwood and softwood mills. Reports were from 1,252 mills whose production was 141,937,000 feet; shipments, 151,516,000 feet; orders received, 170,819,000 feet. Revised figures for the preceding week were mills, 1,297; production, 151,064,000 feet; shipments, 158,331,000 feet; orders, 174,869,000 feet.

On Dec. 22, all of the price-fixing provisions of the Lumber and Timber Products Code were suspended by the National Industrial Recovery Board. The effect is noticeable in a 2.4 drop in the *Engineering News-Record* Cost Index due to the lumber component.

Labor

Employment in the production of six major construction materials, according to the index of the Federal Employment Stabilization Office, is 41.0 for November compared with 40.3 a year ago and 41.3 in October, 1934. This index is based on 1923-25 = 100.

Employment as reported by 1,082 contractors working in New York State in October decreased 2.5 per cent compared with September. Payrolls increased 1.4 per cent and man hours, 0.8 per cent. General decreases in employment, payrolls and hours were reported by general building contractors and highway contractors. In both these groups, employment dropped at a greater rate than either payrolls or hours. Miscellaneous general contractors and sub-contractors employed more workers this month than last with increased payrolls and hours.

Few labor controversies are reported for December. In Washington, carpenters walked off the new Internal Revenue Addition Building on December 3, striking for an increase in wages from $1.10 to $1.25 per hour. They returned the following day at the higher rate. On December 17, the carpenters on the construction of the extra floor on top of the Interior Department Building walked out claiming their wages had been reduced from $1.25 to $1.10. Carpenters on the Woodrow Wilson High School construction were out on a sympathetic strike against the same contractor. This strike was settled on December 19, when the contractor agreed to pay $1.25. On December 7, organized building construction laborers and hod carriers in the District of Columbia won an increase in their wage scales, bringing the rate per hour up to 50c, an increase from 40 and 45c per hour. The new rate is effective December 1 and is in effect until May 1.

The Florida Emergency Relief Administration, FERA District No. 3, on December 5, reduced minimum unskilled labor wage scale to 20c an hour on relief work, a reduction from the former minimum of 30c.

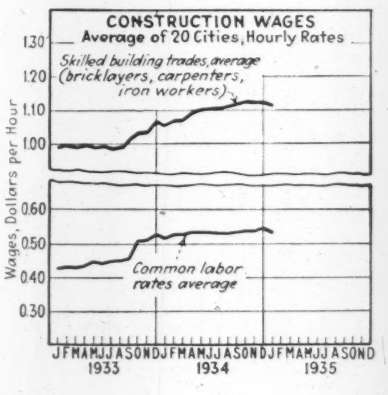
EN-R Cost and Volume Index

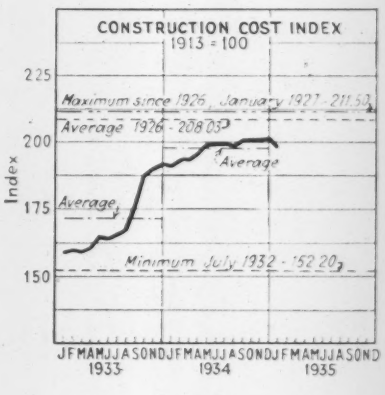
THE *Engineering News-Record* Construction Cost Index for January drops to 198.72. Of this drop, 2.40 is due to lower lumber price, the balance to a slightly lower common labor wage average. This change in the lumber price wipes out the obviously artificial lumber price structure which has existed since September. Accompanying the large drop in the wholesale lumber price used in the index is a slight increase in retail lumber prices in New York.

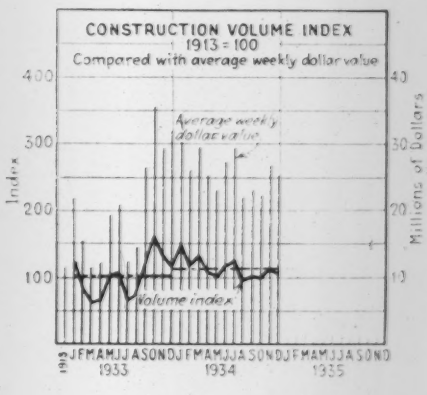
The volume index for December is 105. By including the three big federal dry labor projects, Norris Dam, Fort Peck, and Joe Wheeler, the Construction Volume Index average for the year is 114.

INDEX NUMBER

E.N.-R.-Cost	1913 = 100	1926 = 100	E.N.-R.-Volume	1913 = 100	1926 = 100
Jan., 1935	**198.72**	**95.52**	**Dec., 1334**	**105**	**46**
Dec., 1934	201.86	97.03	Nov., 1934	115	50
Jan., 1934	191.26	91.94	Dec., 1933	116	51
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50
1933 (Av.)	170.18	81.80	1933 (Av.)	102	47
1932 (Av.)	156.97	75.45	1932 (Av.)	127	56


CONSTRUCTION WAGES
Average of 20 Cities, Hourly Rates
Skilled building trades, average (bricklayers, carpenters, iron workers)
Common labor rates average
Wages, Dollars per Hour
1.30
1.20
1.10
1.00
0.60
0.50
0.40
0.30
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1933
1934
1935


CONSTRUCTION COST INDEX
1913 = 100
Maximum since 1926, January 1927 - 211.53
Average 1926 - 208.05
Average
Average
Minimum July 1932 - 152.20
Index
225
200
175
150
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D
1933
1934
1935



CURRENT PRICES OF CONSTRUCTION MATERIALS

CEMENT, AGGREGATES AND READY-MIXED CONCRETE—F.O.B. CITY

	PORTLAND CEMENT (Per bbl., carload lots, including 40c. per bbl. for bags, cash discount not included)			SAND AND GRAVEL (Per ton, carload lots)			CRUSHED STONE (Per ton, carload lots)		CRUSHED SLAG (Per ton, carload lots, f.o.b. plant)		CONCRETE
	Cloth Bags*	Paper Bags	Bulk	Gravel, 1½ in.	Gravel, ¾ in.	Sand	1½ in.	¾ in.	1½ in.	¾ in.	Ready Mixed 1:2:4, 50c y. or more, delivered
Atlanta	$2.89	$2.64	$2.44	$2.31	$2.31	$1.64	$1.69	$1.92	$1.80	$1.80	$8.25
Baltimore	2.66	2.41	2.21	1.80‡	2.00‡	1.25‡	1.80‡	1.80‡	2.25	2.25	7.35
Birmingham	2.55	2.30	2.10	1.75	1.75	1.40	.85	.85	.90	1.15	5.45
Boston	2.72	2.47	2.27	1.60	1.60	1.15	1.60	1.60	.....	.....	7.00
Chicago	2.85‡	2.60‡	2.40	2.60‡	2.60‡	2.05‡	2.60‡	2.60‡	.....	.....	.....
Cincinnati	2.57	2.32	2.12	1.20	1.20	1.10	1.80	1.80	.....	.....	6.70
Cleveland	2.45	2.20	.....	1.55	1.55	1.45	1.60	1.60	1.75	1.75	8.85
Dallas	2.45	2.20	2.00	1.55	1.55	1.10	2.00	2.25	.....	.....	6.50
Denver	2.85‡	.....	.....	1.85	.....	1.25	.....	.....	.....	.....	.....
Detroit	2.25	2.00	1.80	1.40	1.30	1.15	1.10	1.10	1.30‡	1.30‡	6.00
Kansas City	2.40	2.20	2.00	.75p	.75p	.65p	1.30p	1.25p	.....	.....	7.00
Los Angeles	2.90	2.62	.....	1.60	1.60	1.20	1.60	1.60	.....	.....	6.70
Minneapolis	2.85	.....	2.40	1.00p	1.00p	.25p	1.00	1.00	.....	.....	6.90
Montreal	.....	1.70	.....	.....	1.60	1.45	.....	1.25	.....	.....	6.00
New Orleans	2.47	2.22	2.00	1.70	1.70	1.40	.....	.....	.....	.....	7.65
New York	2.65‡	2.40‡	.....	1.30†*	1.30†*	.85†*	1.75†*	1.85†*	.....	.....	7.50
Philadelphia	2.60	2.35	.....	1.80‡	1.90‡	1.50‡	1.75‡	2.00‡	1.75‡	1.75‡	7.75
Pittsburgh	2.45	2.20	1.60	1.50‡	1.50‡	1.70‡	2.25‡	2.25‡	1.50	1.50	7.00
St. Louis	2.42	2.17	.....	1.25‡	1.25‡	1.25‡	.75p	.75p	.75§	.75§	6.50
San Francisco	2.72	2.52	2.20	1.35	1.35	1.35	1.50	1.50	.....	.....	7.53
Seattle	2.95	2.76	.....	1.50†	1.50†	1.50†	.....	.....	3.00	3.00	7.00

*10c. allowed for each returnable bag. †Per cu. yd. ‡Delivered. §F.o.b. Granite City, Ill. *Barge lots alongside dock. pf.o.b. plant. 5 tons or more.

CURRENT MAXIMUM NET PRICES RECEIVED AT CEMENT MILL

Charge for bags not included. For cloth bags, add 40c. per bbl.; 10c. refund allowed for each returnable bag; for paper bags add 15c. per bbl., not refundable.

	Bagged	Bulk		Bagged	Bulk		Bagged	Bulk
Alpena, Mich.	$1.65	$1.60	Ironton, Ohio	$1.60	$1.55	North Birmingham, Ala.	$1.75	$1.70
Buffington, Ind.	1.60	1.55	Iola, Kans.	1.70	1.65	Richard City, Tenn.	1.85	1.80
Crestmore, Calif.	1.72	.....	La Salle, Ill.	1.60	1.55	Saginaw, Mich.	1.65	1.60
Dallas, Tex. (Inc. 5c. tax)	1.80	1.75	Limedale, Ind.	1.60	1.55	Steelton, Minn.	1.80	1.75
Hannibal, Mo.	1.60	1.55	Mason City, Ia.	1.70	1.65	Universal, Pa.	1.65	1.60
Hudson, N. Y.	1.75	1.70	Norfolk, Va.	1.76	1.71	Waco, Tex. (Inc. 5c. Tax)	1.80	1.75
Independence, Kans.	1.70	1.65	Northampton, Pa.	1.65	1.60	Wyandotte, Mich.	1.60	1.55

Cash Discounts, Cement, to Contractors: truck delivery, 2% for cash on 10th of month; on carload deliveries, no trucking, same as dealer cash discount, 10c. per bbl. for payment within 15 days of date of invoice.

STRUCTURAL CLAY BUILDING TILE, BRICK AND LIME—DELIVERED

	STRUCTURAL CLAY TILE—PARTITION—SCORED (Per M, lots of 2,000 pieces or over)			STRUCTURAL CLAY TILE—LOAD BEARING—SCORED (Per M, lots of 2,000 pieces or over)			BRICK (Per M, in quantity)		LIME		
	3x12x12 in.	4x12x12 in.	8x12x12 in.	8x12x12 in.	10x12x12 in.	12x12x12 in.	Common backing	Straight hard	Per ton, Hydrated finishing	in paper, Common hydrated	carload lot, Pulverized or lump
Atlanta	$75.80	$80.80	$151.60	$181.90	$212.20	$242.50	$14.25	$14.25	$24.00	$17.00	$15.90
Baltimore	74.50	80.00	150.00	180.00	209.00	260.00	13.00	17.00	16.75	11.25	19.00
Birmingham	84.25	90.00	156.00	180.00	215.00	242.00	15.00	22.50	3.00§	1.75§	2.25§*
Boston	85.30	91.15	171.00	193.50	239.60	273.40	14.50	17.00	18.75	13.75	3.26g*
Chicago	66.00	70.40	132.00	.....	.....	.....	10.20	11.20	18.00	13.40	14.00
Cincinnati	69.95	74.60	139.90	139.90	174.65	199.20	17.50	17.50	15.97	12.48	.....
Cleveland	62.50	66.50	124.50	149.50	188.00	214.75	16.50	16.50	17.20k	14.50k	2.65kp
Dallas	74.75	80.00	156.50	196.50	240.80	297.00	13.50	28.00	18.20	14.50	1.70 p
Denver	78.50	88.00	141.50	166.50	196.00	225.00	10.00–15.50	21.00–30.00	23.27	16.22	.....
Detroit	63.60	67.80	127.10	230.00	270.00	330.00	11.50	12.50	16.50	14.00	21.56
Kansas City	72.50	75.50	92.00	164.00	169.00	205.00	14.00	23.00	18.20	14.50	2.50§
Los Angeles	77.50	94.25	134.00*	188.00	232.50	311.50	11.50	14.00	18.70	.....	19.70
Minneapolis	78.25x	84.00x	143.00x	165.00x	173.00x	240.00x	13.10	15.10x	25.50	21.00	21.00
Montreal	.....	110.00x	.....	.....	260.00x	.....	15.00	21.50	23.00	13.00	.....
New Orleans	61.60	65.70	123.20	158.90	196.70	.....	14.00	.....	16.60	12.95	.....
New York	84.00	90.00	135.00*	193.30†	238.80†	295.60†	12.00	.....	20.80	16.00	20.80
Philadelphia	80.50	85.90	161.00	182.50	235.00	272.00	15.00	18.00	16.35	11.25	10.75
Pittsburgh	72.65c	77.45c	145.00c	165.00c	217.00c	250.00c	17.50	22.00	14.70	15.10	16.70
St. Louis	62.00	65.00	120.00	165.00	187.00	214.00	15.00	18.00	.48‡	.38‡	2.80p
San Francisco	84.00	94.50	225.00	.....	.....	.....	15.00	18.00	22.50	21.50	2.05p
Seattle	84.00	95.00	180.00	.....	.....	.....	15.50d	15.50	30.00	25.00	3.00p

*6x12x12 in. †F.o.b. Perth Amboy, N. J. ‡Per sack. §Per bbl., 200 lbs. pPer bbl. 180 lbs. gper bbl. 280-lb. kLCL. dless $1 cash 15 days. *lump.
eSmooth. xSelected common.

ROAD SURFACING MATERIALS—F.O.B. CITY

	PAVING BRICK AND BLOCKS			PAVING ASPHALT		ASPHALT BINDERS—FLUXES		CUTBACK ASPHALT		ROAD OILS	ASPHALT EMULSION	
	Granite per M, lots of 50,000, 4x4x8 in.,	Brick per M, 3x8½x4 in., carload lots	Wood per sq.yd., 3½ in., 16-lb. treat.	Per ton, less than 80 penetration, Tank car	Drums	Per gal., 80-300 penetration, Tank car	Drums	Per ton, Tank car	Drums	Per gal., Tank car	Per gal., Tank car	Drum
Atlanta	$ 80.00	$35.00*	$2.25	$17.40z	$22.47z	$0.0694z	$0.961z	$19.65z	$25.57z	$0.0694z	$0.105	$0.105
Baltimore	130.00	44.00	2.25	17.00	22.00	.07	.095	.085†	.12†	.....	.....	.....
Birmingham	125.00	24.00	.....	18.00	23.00	0.778	.1028	.082†	.112†	.....	.06	.....
Boston	90.00	33.00	2.50	16.00	21.00	.075	.10	.09†	.12†	.075	.09	.125
Chicago	138.00	42.00	2.60	.....	.....	.....	.....	.....	.....	.....	.....	.....
Cincinnati	115.00	37.00	.....	18.00	22.00	.09	.....	18.50	.....	.07	.08	.....
Cleveland	100.00‡	32.75	2.95	20.00	24.50	.075	.09	.075†	.049†	.06	.085	.10
Dallas	.....	30.50	.....	15.40	21.10	.06	.10	16.40	24.40	.055	.1076	.1438
Detroit	.....	37.00	.....	19.67c	24.87c	.....	.....	17.00	22.50	.....	.....	.....
Kansas City	.....	45.00	2.50	13.70	18.70	13.55#	18.55#	.0603†	.0853†	.03	.11	.16
Los Angeles	.....	50.00	.....	10.34	14.50	10.34#	14.50#	10.34	.....	.042	.06	.12
Minneapolis	.....	.....	2.50	18.10	24.60	.098	.098	21.75	34.55	.048	.....	.....
Montreal	.....	110.00	.....	14.00	19.66	.07	.093	19.00	26.00	.07	.125	.155
New Orleans	100.00	35.00	.....	14.50	18.50	.065	.09	.07†	.10†	.....	.....	.....
New York	137.50§	50.00	2.64	17.00	22.00	.07	.095	.085†	.12†	.085	.12	.....
Philadelphia	120.00	45.00	2.25	15.00	20.00	.06	.....	.07†	.10†	.06	.....	.....
Pittsburgh	115.00	40.00	.....	19.00	24.00	.0775	.1125	.086†	.121†	.0675	.....	.....
St. Louis	105.00	35.00	2.00	19.50	24.50	.0775	.1075	.0875†	.118†	.04	.09	.125
San Francisco	.....	50.00	.....	12.00	18.00	12.00#	18.00#	12.50#	23.00#	.04	.0575	.117
Seattle	.....	47.50	.....	18.00	23.85	18.00#	23.10#	15.00	.....	.03	.1920#	34.20#

Note: Paving asphalt, tank car or boat, f.o.b. Maurer, N. J., per ton, Bermudez, $25.00; Trinidad, $21.00. *Per sq. yd. †Per gallon ‡4½x6x5½in. #Per ton §4x5x9-in. Av. zMexican. cLocal reduction due to 20% reduction intra-state class freight rates, only Georgia affected.

CURRENT PRICES OF CONSTRUCTION MATERIALS

IRON AND STEEL PRODUCTS—BASE MILL PRICES

	STRUCT. SHAPES-PLATE	REINF. BARS ¼-in. billet,	RIVETS ¾-in. structural	WIRE NAILS Base	SHEET PILING Base	STEEL RAILS Per Gross Ton Standard	Light	Re-rolled	TRACK SUPPLIES Angle bars	Std. spikes	Tie plates	Track bolts
Birmingham	$1.95	$2.10	.....	.....	.....	$36.375	$34.375	$35.00	$2.55	$2.40	$1.90	$3.55
Chicago	1.85	2.10	$3.00	.....	$2.25	36.375	35.00	34.00	2.55	2.40	1.90	3.55
Pittsburgh	1.80	2.05	2.90	$2.60	2.15	36.375	35.00	34.00	2.55	2.40	1.90	3.55

IRON AND STEEL PRODUCTS—BASE MILL PRICES, PER 100 LB., CARLOAD LOTS

F.O.B. WAREHOUSE	STRUCTURAL SHAPES Per 100 lb., base price	REINFORCING BARS Per 100 lb., ¼ in., base price New billet	Rail steel	EXPANDED METAL LATH —Per 100 sq. yd., carload lots— Std. diamond mesh, 3.4 lb.	Std. ribbed 3.4 lb.	WELDED FABRIC REINFORCING —Per 100 s.f., carload lots— 4x16 in., No. 5 & 10 wires	4x12 in., No. 8 & 12 wires	6x6 in., No. 6 & 6 wires Per sq. yd.	SHEET PILING Per 100 lb., base price
Atlanta	$3.34	$2.32	$2.17	$21.00	$24.00	$1.53	$1.16	$0.1449	$2.65
Baltimore	2.95	2.75	2.60	22.00	25.00	1.41	1.08	.1332	2.75
Boston	3.52	3.03	2.2125	20.00	24.00	1.46	1.12	.1449	2.30
Chicago	3.20	2.10	1.95	22.00	26.00	1.40	1.08	.1323	2.25
Cincinnati	3.40	3.25	3.25	25.01	29.50	1.39	1.07	.1287	.....
Cleveland	3.16	2.60	2.45	20.00	23.00	1.37	1.05	.1287	.....
Dallas	4.00	2.80	2.65	24.50	26.50	1.63	1.23	.1548	2.985
Denver	3.91	3.76	.....	25.00	27.50	1.68	1.25	.1548	.....
Detroit	3.40	2.885	2.885	20.20†	25.60†	1.41	1.05	.1323	2.25
Kansas City	2.75	2.85	2.65	20.50	22.50	1.53	1.14	.1422	2.65
Los Angeles	3.10	2.95	.....	23.00	27.50	1.68	1.25	.1584	2.50
Minneapolis	3.45	2.82	2.67	22.00	26.00	1.51	1.15	.1431	2.55§
Montreal	3.50	3.00	2.80	.....	.....	.....	.....	.....	3.30
New Orleans	.....	.....	.....	19.15	23.00	1.54	1.17	.1458	.....
New York	3.37	2.82	2.67	20.00	22.00	1.43	1.13	.1350	2.48
Philadelphia	2.005	2.34	2.19	20.00	23.50	1.42	1.09	.1332	2.44
Pittsburgh	1.80‡	2.05‡	1.90‡	20.75‡	23.00‡	1.38	1.04	.1260	2.15
St. Louis	3.44	2.94	2.79	20.00	22.00	1.42	1.07	.1341	2.25
San Francisco	3.55	2.475	2.35	23.00	28.00	1.68	1.25	.1584	2.60
Seattle	3.55	3.50	.....	.....	.....	1.68	1.26	.1584	.....

‡Base Mill Price. Note: Shapes, bars and piling subject to quantity discounts. §Mill Price plus freight to Minneapolis. †f.o.b. delivered

PAINTING AND ROOFING SUPPLIES—F.O.B.

	WHITE LEAD Per 100 lb. keg in oil	READY-MIXED PAINT Per gal., drums Graphite*	Aluminum†	Ferric Oxide‡	ROOFING SUPPLIES Carload lots, f.o.b. factory — Rolls, slate surfaced, 85-90 lb., per sq.	Asphalt felt, per 100 lb.	Tar felt, per 100 lb.	Asphalt coating, per gal.	Tar pitch, 350 lb. bbl., per ton
Atlanta	$11.50	$1.60	$3.10	.....	$1.81	$1.97	$2.90	$ .36	$25.40
Baltimore	11.00	1.40	2.25	$1.90	2.32	2.55	2.55	.48	24.60
Birmingham	11.50	2.35	2.35	1.85	1.95	1.79	.....	.36	23.00
Boston	10.25	1.75	2.60	.04¼x	2.15	3.25	3.25	.46	30.00
Chicago	11.00	1.85	2.45	1.30	1.60	1.59*	1.59*	.24	20.00
Cincinnati	11.00	1.40	3.00	1.55	2.40	2.39*	2.39*	.36	21.00
Cleveland	11.00	1.65	2.30	1.30	1.60	1.79	1.79*	.24	22.00
Dallas	12.00	1.80	2.24	.....	3.15	2.56§	2.56§	.43	30.25*
Denver	11.75	2.55	.....	.....	2.75	3.40	3.40	.51	30.00
Detroit	11.00	1.45	2.20	1.30	2.55	2.80	2.80	.37	30.00
Kansas City	11.12½	1.75	2.25	1.85	1.75	1.85	2.25	.35	26.75
Los Angeles	10.75	1.60	2.25	2.30	2.00	1.50	.....	.45	.....
Minneapolis	11.12½	.....	.....	.....	1.80	1.79*	1.79*	.24	25.10
Montreal	9.40	1.70	3.45	1.65	2.00	2.62	2.02	1.43§	1.52§
New York	11.00	1.70	2.35	1.55	1.80	1.79*	1.79*	.252	22.00
Philadelphia	11.00	1.50	2.05	1.50	1.68	1.85*	1.85*	.34	22.00
Pittsburgh	11.00	1.05	1.95	.80	1.75	1.65*	1.65	.58	22.00
St. Louis	11.00	1.85	2.45	1.30	2.25	3.22	3.88	.24	20.00
San Francisco	10.75	1.80	2.75	1.10–2.00	1.89	3.10	3.10	.38	26.00
Seattle	10.75	.....	1.92	.....	3.10	4.50	.....	.50	27.60

*U. S. War Dept. Spec. 3-49A. †ASTM Spec. D266-31. ‡80% maximum ferric oxide. §Per 100 lb. ▲Per roll, 65 lb. xPer lb. *500-lb. drums.
Note: Red lead dry, same as white lead in oil, red lead in oil 50c higher.

MISCELLANEOUS ITEMS

WINDOW GLASS

Discounts from latest jobbers list, Sept. 15, 1928

	Single or Double Thickness A quality	B quality
Atlanta	85%	85%
Baltimore	88–10%	90–10%
Birmingham	88%	90%
Boston	88–10–5%	90–10–5%
Chicago	90%	92%
Cincinnati	89–10%	91–10%
Cleveland	89-10%	91-10%
Dallas	88%	92%
Denver	86%	88%
Detroit	87–10%	89–10%
Kansas City	90–10%	90–10%
Los Angeles	90%*	90–40%
Minneapolis	85%	87%
Montreal	.....	.....
New Orleans	88%	90%
New York	88%	90%
Philadelphia	88–30%	90–30%
Pittsburgh	88%	88%
St. Louis	90%	92%
San Francisco	90%	90–‡10%
Seattle	90–10%	90–20%

*Disc. from list Aug. 1, 1929. †F.o.b. Arsenal.

EXPLOSIVES

Per lb. dynamite delivered 50-lb. cases

Gelatin 40%	60%
$0.155	$0.17
.16	.175
.105	.120
.165	.1775
.....	.....
.27	.29
.19	.205
.17	.185
.1525	.1675
.237	.255
.14	.18
.1725†	.1925†
.17	.185
.1925	.2175
.19	.22
.22	.235
.....	.....
.105	.12
.13	.145
.1575	.1775
.1425	.1575

‡Double thickness A & B.

CHEMICALS

Water, sewage treatment, road work, f.o.b., carlots, New York	
Bleaching powder, in drums, f.o.b. works, per 100 lb.	$1.90@$2.15
Calcium chloride, 77-80%, flaked, in 400-lb. drums or 100-lb moisture proof bags, f.o.b. works, freight equalized with points of competition, per ton	19.50
Chlorine, cylinders, per lb. delivered	.05½
Silicate of soda, 52 deg., in drums, f.o.b. works, per 100 lb.	1.35
Soda ash, 58%, in paper bags, per 100 lb	1.20
Sulphate of aluminum, commercial, in 100 lb. bags per ton	27.00
Sulphate of copper, in bbl., per 100 lb.	3.85

PILES

Prices per linear foot, pine, with bark on f.o.b., New York; delivered from barge, 1½ to 2c. per ft. additional:

Dimensions	Points	Length	Short Leaf Barge	Short Leaf Rail	Long Leaf Barge	Long Leaf Rail
12 in. at butt	6 in.	30 to 50 ft.	$0.11	$0.155	$0.12	$0.15½
12 in.—2 ft. from butt	6 in.	50 to 59 ft.	.15	.20	.14	.19
12 in.—2 ft. from butt	6 in.	60 to 69 ft.	.16	.215	.15	.20½
14 in.—2 ft. from butt	6 in.	50 to 69 ft.	.185	.225	.19½	.23½
14 in.—2 ft. from butt	6 in.	70 to 79 ft.	.2025	.225	.23½	.29½
14 in.—2 ft. from butt	5 in.	80 to 85 ft.	.255	.325	.....	.....
14 in.—2 ft. from butt	5 in.	85 to 89 ft.	.305	.442	.....	.....

RAILWAY TIES

Prices f.o.b., per tie, for carload lots:

		6 In. x 8 In. by 8 Ft.	7 In. x 9 In. by 8½ Ft.
Boston	Oak, untreated	$0.95	$1.35
	Pine, untreated	1.00	1.40
	Pine, creosoted	1.45	2.00
New York	Long-leaf sap pine, untreated	.80	1.00
	Mixed oak, untreated	.....	1.00
	White oak, untreated	.75	1.50
Birmingham	White oak, creosoted	no market	
	Southern pine, untreated *6x8x8'6"	.45*	.60
	Southern pine, creosoted	1.01*	1.20
Chicago	White oak, untreated	1.15	1.40
	Oak, empty cell, creosoted	1.50	1.88
	Oak, zinc treated	1.40	1.70
	Southern pine, creosoted	1.35	1.78
Los Angeles	Fir, untreated	.50	.72
	Fir, creosoted	1.67	2.40
Philadelphia	Red oak, untreated	1.15	1.35
	Red oak, creosoted	1.40	1.65
St. Louis	White oak, untreated	1.10	1.45
	Red oak, untreated	1.08	1.40
	Red oak, creosoted	1.45	1.95
San Francisco	Sap Pine or cypress, untreated	.85	1.25
	Douglas fir, green, untreated	.45	.63
	Douglas fir, empty cell, creosoted	1.14	1.56
Montreal	Birch or maple, untreated	1.00	1.00
	Birch or maple, creosoted	1.25	1.55

CURRENT PRICES OF CONSTRUCTION MATERIALS

WATER, SEWER AND DRAIN PIPE

	C. I. PIPE	VITRIFIED SEWER PIPE				CLAY DRAIN TILE		CONCRETE SEWER PIPE		WROUGHT STEEL PIPE			
	Per net ton, f.o.b. 6 in. and over*	Per foot, delivered, standard (‡ f.o.b.) 8 in., s.s.	12 in., s.s.	24 in., d.s.	36 in., d.s.	Per 1,000 ft., carload lots, f.o.b. 6 in.	8 in.	Per ft., delivered; ASTM C 14-24 12 in.	24 in.	Full standard weight, # 1 to 3 in., Butt Weld Black	Galv.	3½ to 6 in., Lap Weld Black	Galv.
Atlanta	$42.00	$0.225	$0.405	$1.4625	$3.25	$80.00	$128.00	$0.55	$1.60	44%	37%	42%	34%
Baltimore	45.50	.24	.46	2.05	5.65	105.00	165.00	.75	2.00				
Birmingham	38.00	.25	.45	1.625	4.66	85.00	200.00	.45	1.60	48.939%	37.918%	50.162%	39.143%
Boston	45.50	.231	.4455	2.025	5.945	60.10	101.00	.54	2.00				
Chicago	46.50	.28	.54	1.98	5.60	85.00	120.00	.675	2.25	56%	45%	55%	57%
Cincinnati	45.00	.231	.4455	1.935	5.8425	69.00	108.00	.40	1.40	53.04%	42.02%	54.265%	43.245%
Cleveland	46.50	.21	.405	1.755	5.2275	47.25	72.00	.536	2.102	58.4%	48.4%	60.6%	49.6%
Dallas	50.00	.27	.486	1.944		120.00	150.00	.45	1.52	64%	55%	65-5%	56-5%
Denver	58.00	.23‡	.415‡	1.73‡						56%	45%	43%*	57%*
Detroit	46.50	.238	.456	1.935	5.74	67.15	112.32	.35	1.55	48.6%	38.2%	47.3%	37.6%
Kansas City	48.00	.32	.57	2.25	4.85			.85	2.25				
Los Angeles	46.50	.2825‡	.508‡	2.03‡	5.535‡	115.50	192.50	1.00	2.00	53.57%	43%	53%	42.51%
Minneapolis	48.50	.283	.51	2.04	5.13			.50	1.33				
Montreal		.80	1.50	6.00									
New Orleans	44.00	.275	.462	1.62		60.00		.51	1.69				
New York	45.00	.322	.621	2.73	7.60			.55	2.00	51.88%*	40.86%*	53.10%*	42.08%*
Philadelphia	42.00	.315	.6075	2.70		150.00	230.00			52.37%*	41.35%*	53.39%*	42.57%*
Pittsburgh	48.00	.224‡	.432‡	1.845‡	5.535‡	69.00	108.00	.75	1.75	64%	55%	65%	56%
St. Louis	45.00	.27	.486	1.944	3.96	70.00	160.00	.80	2.28	51.51%	40.49%	52.74%	41.71%
San Francisco	46.00	.265	.477	1.908	5.22	105.00	175.00	.45	2.20	52.4%	63.4%	51.1%	64.6%
Seattle	47.50	.35	.63	2.52		85.00	200.00	1.50	1.60	60.3%	51.3%	65.3%	52.3%

*b. & s. class B and heavier, C. I. lots. Burlington, N. J. (base) $42.00. Gas pipe and class A, $3 per ton additional, 4-in., $3 per ton additional.
‡Price at factory.
‡Discounts from standard list for delivery from warehouse, except Pittsburgh prices are f.o.b. mill. Base price $200 per net ton. List prices per ft.: ½ in., 8½c.; ¾ in., 11½c.; 1 in., 17c.; 2 in., 37c.; 2½ in., 58½c.; 3 in., 76½c.; 4 in., $1.09; 6 in., $1.92.
*2½ to 3 in. *Resale price to consumer, car load lots shipped from mill.

LUMBER AND TIMBER—PER M FT. B.M., CARLOAD LOTS F.O.B.

		SHORT LEAF YELLOW PINE AND DOUGLAS FIR — All S. L. Y. P. is No. 2 common or better and for No. 1 N. C. Box. All Fir planks No. 2 common; Fir timber is No. 1 common. Lengths up to 20 ft.								LONG LEAF Y. P. Merchantable grade up to 20 ft.	
		1x6, S4S	1x8, S4S	2x4, S4S	2x6, S4S	2x8, S4S	2x10, S4S	3x12, Rgh.	6x12, Rgh.	12x12, Rgh.	2x12, Rgh.	12x12, Rgh.
Atlanta	Southern Pine	$18.00	$19.00	$21.00	$18.50	$20.00	$20.50	$28.00			$38.50	$40.00
Baltimore	Southern Pine	23.00	24.00	29.50	28.50	29.60	30.50	37.50			54.00	55.00
	Douglas Fir	29.00	29.00	31.00	29.00	30.00	30.50	30.00	$30.00	$30.00		
Birmingham	Long Leaf	18.25	19.25	21.25	19.25	20.25	20.25	42.00			32.00	39.80
	Southern Pine	18.25	19.25	20.00	18.00	19.00	19.00	29.00	29.00	28.00		
Boston	Southern Pine	33.00	35.00	40.00†	41.00†	58.00‡	67.00‡	77.00‡			77.00	77.00
	Douglas Fir	31.25	33.50	40.50	40.25	40.75	41.00	44.00	44.00	44.00		
Chicago	Southern Pine	27.00	28.00	33.50	30.00	31.00	32.80	45.00			54.00	58.00
	Douglas Fir	28.50	29.50	31.75	30.50	30.50	28.50	40.75	41.75	41.75		
Cincinnati	Southern Pine	26.00	27.00	27.50	25.50	26.50	27.50	43.50			43.50	
	Douglas Fir							46.25	46.25	46.25		
Cleveland	Southern Pine	28.50	29.50	31.00	28.00	30.25	30.50	45.00	45.00		46.00	57.00§
Dallas	Southern Pine	26.25	27.10	29.02	26.27	27.92	28.72	42.44			47.55	55.55
	Douglas Fir	29.45	30.53	33.28	30.53	38.64	32.45	44.85	44.85	44.85		
Denver	Douglas Fir	34.50	34.50**	38.50*	37.50*	36.00*	40.50*	45.00*	50.00*	55.50		
Detroit	Southern Pine	26.00	27.50	30.00	27.00	30.00	32.00	37.00			32.00	43.75
	Douglas Fir							43.25	44.25	44.25		
Los Angeles	Douglas Fir	27.00,	28.50,	28.50,	25.00,	25.50,	25.50,	35.00,	*34.00,	34.00,		
Minneapolis	Western Pine	44.00*	41.25*	34.00*	31.50*	33.00*	31.50*	50.75*◦				
	Douglas Fir	33.25*	34.50*	36.00*	33.50*	35.00*	37.00*	47.00*	50.75*	50.75*		
Montreal	Spruce	30.00	31.00	27.00	29.00	30.00	35.00	34.00				
	Douglas Fir	42.50	42.50	42.50	44.00	44.00	45.75	51.00	51.00	51.00	42.00	
New Orleans	Southern Pine	27.40	28.95	33.70	29.90	31.35	32.40	43.95			45.65	52.45
	Douglas Fir	25.95	31.50	33.95	29.35	32.90	33.95	37.95				
New York	Southern Pine	32.50*	34.00*	32.50*	34.00*	35.00*	36.00*	47.00*			75.00*	75.00*
	Douglas Fir			40.00*	37.50*	38.50*	40.00*	34.00*	34.00*	34.00*		
Philadelphia	Southern Pine	24.50	25.50	27.00	25.50	26.50	27.00	31.00			61.00	54.00
	Douglas Fir			31.00	31.00	31.00	31.00	32.50	32.50	33.50		
Pittsburgh	Southern Pine	26.50	27.75	31.75	29.25	31.75	32.75	41.50			57.50	57.50
	Douglas Fir	33.50	34.50	34.50	33.50	34.00	34.25	46.25	46.25	46.25		
St. Louis	Southern Pine	32.25*	33.75*	35.25*	32.25*	33.75*	33.75*	55.25*			44.00*	71.00*
	Douglas Fir							54.25*	54.25*	54.25*		
San Francisco	Douglas Fir	15.00◦	16.00◦	17.00◦	14.50◦	15.50◦	16.50◦	21.00‡	21.00‡	21.00‡		
Seattle	Douglas Fir	22.50	21.50	21.50	21.00	22.50	22.50	20.00	20.00	22.00		

*Delivered. †Spruce. ‡Long-leafed Y. P. §Norway Pine. ◦Northern Pine. ‖Douglas fir. **Native. ‡‡Ship's tackle. ,Yard prices.

CURRENT BUILDING AND CONSTRUCTION WAGE RATES PER HOUR

	Bricklayers	Carpenters	Structural Iron Workers	Housing Engineers	Plasterers	Common Labor — Building	Common Labor — Heavy Const.
Atlanta	$0.70 / 1.125	$0.40 / .90	$0.60 / 1.25	$0.90 / 1.25	$0.90 / 1.00	$0.30 / .40	$0.30 / .40
Baltimore	1.25	1.10	1.37½	1.25	1.25	.45	.40
Birmingham	1.00	.90 / 1.00	1.00	1.125	1.00	.30 / .40*	.30 / .40*
Boston	1.20	.70 / 1.17½	1.20	.40 / 1.37½	.90 / 1.37½	.40 / .70	.40 / .70
Cincinnati	1.27½	1.02½	1.20	1.02½	1.27½	.45	.40
Chicago	1.50	1.31¼	1.55	1.31¼	1.50	.81¼	.81¼
Cleveland	1.25	1.12½	1.25	1.25	1.25	.72	.72
Dallas	1.00	1.00	1.15	.75	1.00	.40	.40
Denver	.90 / 1.12½	.90 / .87½	.90 / .87½	.90 / .87½		.50	.50
Detroit	1.25	1.00	1.25	.25 / .95	1.25	.50	.50 / .70
Kansas City	1.12½	1.12½	1.25	1.12½	1.12	.50 / .60	.90 / .75
Los Angeles	1.10	1.10	1.125	1.10	1.25	.50	.60
Minneapolis	.40 / 1.00	.75	.40	.75	.90	.40	.50
New Orleans	1.00	.75	1.00	1.00	1.25	.30 / .40	.30 / .40
New York	1.50	1.40	1.45 / 1.93	1.50 / 1.93	1.50	.42½	.82½ .93¾
Philadelphia	.75 / 1.20	.90 / 1.20	1.00 / 1.29	.75 / 1.20	.90 / 1.20	.30 / .50	.30 / .50
Pittsburgh	.50 / 1.00	.50 / 1.00	.50 / 1.00	.50 / 1.00	.90 / 1.00	.35 / .50	.35 / .50
St. Louis	1.50	1.25	1.47	1.35 / 2.47	1.50	.78½	.35 / .78
San Francisco	1.50*	1.10	1.37½	1.12½	1.25*	.62½	.60
Seattle	1.25	1.12½	1.37½	1.25	1.50	.70	.70
Montreal	0.70	.90	.75	.55	.67	.35	.25

Skilled Avg. (Bricklayers, Carpenters, Ironworkers) $1.11.39. Common Avg. $0.5379. *8-hr. Day. †PWA.